COMPUTER-ASSISTED INSTRUCTION

A SURVEY OF THE LITERATURE

Second Edition

January 1967

Albert E. Hickey

John M. Newton

Prepared under
Office of Naval Research
Contract Nonr 4757 (00)
Project NR 154-254

ENTELEK, Incorporated

Newburyport, Massachusetts 01950

(617) 465-3000

ABSTRACT

A selective review of 242 documents related to computer-assisted instruction (CAI). Principal headings: CAI Reviews and Bibliographies, Applications of CAI, Major CAI Centers, CAI Systems Studies, CAI Languages, Instructional Theory, and Program Preparation and Evaluation. An appendix lists 140 CAI programs. The review will be updated semiannually.

PREFACE

Payroll, record keeping, scheduling, research calculations, instruction, counselling, and library information retrieval are only a few of the many functions computers are performing in education. All of these functions may be grouped under the general heading of "computer-assisted education." In this review, however, we are concerned primarily with computer-assisted instruction, those applications in which the student interacts, or is "on line" with the computer with the ultimate goal of improving the student's performance. Computer-assisted instruction includes such interaction as tutoring, case study, gaming, laboratory simulation, counselling, and library information retrieval.

In limiting the scope of the review to computer-assisted instruction (CAI), the authors have tried to give the report meaningful depth by devoting significant space to the behavioral factors that are critical in a computer-assisted instructional system, principally learning, perception, decision-making, motivation and individual differences.

Although CAI has infinitely more potential than programmed instruction (PI), the two methods are logically related and share some important common factors. As evidence of this relationship, some CAI programs have been developed from programmed instruction texts, notably at the University of Michigan Center for Research on Learning and Teaching and the University of Pittsburgh Learning R & D Center. Consequently, the authors have included in the survey some experimental investigations of programmed instruction texts they consider relevant to CAI.

The first edition of this report (Hickey & Newton, 66-0104), published in January 1966, was based on approximately 100 documents compiled by ENTELEK under contract Nonr-4757(00). As of October 1966 over one hundred and forty more documents had been added to the file. This report summarizes and integrates all information received up to October 1966.

Citations are by author's name and the ENTELEK six-digit serial number. Five-digit numbers in the old system have been converted to a uniform six-digit format by the addition of a zero at the beginning of the three-digit suffix. The first two digits of the serial number represent the year in which the report was published and the second two digits stand for the month of publication.

The authors are indebted to all those persons who have submitted documents and abstracts to the information exchange, and particularly to Drs. Glenn Bryan and John Nagay of the Personnel and Training Branch, Office of Naval Research, and Dr. James Regan, now of the Naval Training Device Center, who have monitored and constructively contributed to the development of the system from the beginning.

AEH and JMN

Newburyport, Massachusetts

1 January 1967

CONTENTS

I. REVIEWS, BIBLIOGRAPHIES, AND GENERAL DISCUSSIONS OF CAI

In addition to the first ENTELEK literature survey (Hickey & Newton, 66-0104), an excellent review of the CAI field has been written by Zinn (65-1108). He reviews 24 CAI projects, including a description of each project and the names and addresses of the individuals concerned. There is a bibliography of 103 titles.

Some bibliographies of work performed using specific CAI systems are also available. Stolurow (65-0912) lists reports of studies using SOCRATES, and Lyman (65-0702, 66-0602) has provided annotated lists of programs based on the PLATO system.

Dick (65-0106) described the development and current status of computer-based instruction, including (1) learning principles, (2) current computer-instruction projects, (3) typical computer-instruction equipment, (4) programs and programmed texts, (5) research with computer instruction, (6) programming and equipment improvements, (7) current problems, and (8) future prospects.

Filep (66-1001) lists the unique characteristics of CAI and the potential high-priority applications, and compares the impersonal nature of CAI with "live" instruction. The author also comments on several possible system configurations and describes a current project to use CAI for in-service teacher education. He concludes with a list of six research objectives.

Several authors have discussed the developing potential of CAI in a more general vein. Bolt (65-0707) sees CAI as a useful partner of book- and teacher-aided instruction. He points out that a system which accommodates both CAI and educational management could evolve into an information environment of extraordinary power for educational research. Bushnell (64-0203) not only reviews the development of computer-based teaching machines, but also describes (1) the potential use of rapid information retrieval systems in instruction and (2) the possibilities for computer-aided diagnosis of student learning needs.

In an article in the Scientific American, Suppes (66-0902) gives a very clear rationale for CAI, demonstrating its advantages largely in terms of the Stanford CAI project.

Kopstein identifies and discusses six CAI areas requiring research: subject-matter structure, instructor-student informational coupling, measurement of progress, motivation and differences.

The availability of CAI will also have an important effect on contemporary research on learning and stress. Davis and Stolurow (64-1106) point out that CAI equipment makes possible the study of response contingency variables which cannot be investigated in any other way. They draw illustrations from research studies using SOCRATES. Seidel (65-1212) relates PI to CAI, both as a medium for the application of principles of learning and as a means of furthering our understanding of learning processes.

In a broadly based paper on the technology of training, Eckstrand (64-0903) holds that the psychology of learning is at last bridging the gap between basic science and a practical technology. He sees the individualization of training, including CAI, as a promising research area.

The implications of CAI for the education industry were discussed in an article in Forbes Magazine (65-1101) and, in a different vein, in a speech by Louis Bright (66-0603), Associate Commissioner of Education for Research. Forbes cited the increased bonds between the publishing, communications and electronics industries. Bright emphasized the increasing need for industry participation in research and, particularly, in the development of educational technology. Both presentations stressed software development as a key problem.

In an article in Science, Carter (66-0901) describes in journalistic fashion the changing roles of the Office of Education, industry and the education "establishment" under the influence of the new technology. A similar picture is detailed in FORTUNE (66-0809).

There has been some consideration of the role of computers, not just in the computer-assisted instruction, but in the education process generally. MacDonald (64-0304), while emphasizing adaptability of CAI lessons to individual needs, also considers the use of computers for automated class scheduling, etc. Packer (64-0305), in a better documented article (75 references), lists seven categories in discussing the application of computers to automated education: educational administration, military training, reference and research automation, school counseling, sports, teaching, and training in computer technology.

Interest in CAI is not limited to the United States. Nagay (65-1213), reported on a conference on CAI held at the Office of Naval Research Branch Office in London in May 1965 in which both U.S. and United Kingdom representatives participated. Nagay (66-0506) also described progress on CAI in Russia. Linsman, Houziaux and Piette (65-0713) describe DOCEO, the CAI system in use at the University of Liege, Belgium, to teach French grammar, algebra and Latin.

II. APPLICATIONS OF CAI

A. INSTRUCTIONAL PROGRAMS BY SUBJECT MATTER

CAI programs are elusive. Generally they exist on paper or magnetic tape Printouts of the instructions to the computer and of characteristic student-computer interaction are sometimes available, but not through customary publication channels in the manner of a textbook or programmed instruction text. To overcome this problem, ENTELEK compiles sixteen-point descriptions of CAI programs available or in development. One hundred and forty programs described in the ENTELEK catalog at the date of publication are listed in the Appendix.

The ENTELEK list is not the only compilation of data on operational CAI programs, although it appears at this writing to be the most comprehensive. Zinn (65-1108) earlier listed 89 CAI programs, including data on subject-matter, author, system, language, terminal characteristics and availability. Most of the programs in Zinn's list are also described in the ENTELEK catalog. Of the 89 programs in Zinn's list, 65 are an hour or more long and not specifically designated as demonstration programs. Of these 65 programs, 57 have been run on a CAI system and 26 are listed as having received some form of empirical evaluation. The availability of the programs in Zinn's list is uncertain as he did not request this information in his survey.

Elisabeth Lyman (66-0602) provides a comprehensive index of programs developed at the University of Illinois for use on the PLATO system. The programs are classified by the type of teaching logic used, or by their research use.

Catalogs and lists are not the only source of data on CAI programs. Many programs are described in greater detail in research reports. Notable among such reports is that by Suppes, Hansen and Jerman (65-1105). They outline 320 sessions, 160 each for spelling and arithmetic, developed at the Stanford Computer-Based Laboratory for Learning and Teaching and now in use at the Brentwood Elementary School, East Palo Alto. Each session is of 30 minutes duration, the student engaging in two sessions per day, one each in spelling and arithmetic.

Suppes (65-0104) and Suppes, Jerman, and Groen (65-1101) describe the Stanford mathematics programs for grades 1, 4, and 6. Six concepts are taught by computer in grade 1: (1) use of light pen, (2) concrete objects to show sets, (3) set notation to show sets, (4) empty set, (5) equal sets (2-answer choices), and (6) equal sets (3-answer choices).

Instructional material is adapted with little change from Suppes' Sets and Numbers books. The report shows examples of the optical display formats used.

In grade 4, eleven concepts are taught: (1) place value, (2) addition, (3) subtraction, (4) multiplication, (5) division, (6) word problems and equation, (7) operations on numbers, (8) commutative law, (9) associative law, (10) deductive steps in problem solving, (11) distributive law. In grade 6 the students learn mathematical logic.

Atkinson and Hansen (66-0305) describe the Stanford CAI curriculum for teaching initial reading. The article includes a description of the Stanford CAI IBM/ System 1500, the nature of reading lesson preparation and software example, the nature of the initial reading curriculum and some tentative empirical results by five-year-olds utilizing this material. A brief description is given of certain optimal quantitative models for instruction in the reading area.

Hansen, Atkinson and Wilson (66-0303) have compiled a reading lesson which illustrates the richness of the decision structures utilized in the computer-based Stanford Initial Reading Project. The illustrative lesson covers (1) letter discrimination, (2) vocabulary acquisition, (3) decoding problems, and (4) syntactic and intonation practice with words, phrase, and sentence materials. The illustrative lesson, intended for the Stanford IBM/System 1500 includes instructional format and execution statements.

Hansen (66-0204) reviews three studies of reading using the Stanford system. One reports the progress of six-year-olds learning to read with proper oral intonation. The second study illustrates some of the problems and requirements for daily CAI spelling lessons, and the third describes a detailed experiment in spelling that compares the variables of list-length and the form of feedback.

Near the other end of the educational spectrum, Bachman (62-0002) describes two CAI lessons on the synthesis of two-terminal reactive networks programmed for the PLATO II teaching system and used in the electrical engineering curriculum at the University of Illinois.

Johnson (66-0705) also used the PLATO system to teach electrical network analysis (EE322, University of Illinois). Two groups of students were selected to use each of the two types of instruction logic, inquiry and tutorial. Both the instruction sequences were to achieve the same performance objectives. The desired performance objectives were obtained satisfactorily in both cases, although in certain aspects the inquiry teaching program exhibited some advantages.

Malpass, et al (63-0701) compared two automated teaching procedures for helping retarded children acquire certain word recognition, reading, and spelling skills in contrast to conventional classroom instruction. They also compared the effectiveness of the two automated procedures selected, i.e., (1) a multiple-choice presentation and (2) a typewriter-key-board (modified completion) presentation.

Both automated procedures were more effective than conventional classroom instruction, and provided gains comparable to individual tutoring. Both types of programmed instruction engendered extraordinarily high levels of retention over a 60-day period. Multiple-choice and keyboard methods were not significantly different from each other in terms of teaching word-recognition and spelling.

B. STUDENT COUNSELLING

Although the computer has many functions in education, this review is primarily concerned with those educational applications in which the student is placed "on line," or in the loop, with the computer in order to improve the performance of the student. Although counselling may only indirectly improve the performance of the student, we have included computer-assisted counselling in the purview of this report.

Cogswell and Estavan (65-0804) of the System Development Corporation have developed a system for computer-assisted counselling. They use computer programs and computer-controlled equipment to simulate a school counselor's cognitive behavior in the appraisal of student information and his overt verbal responses in the educational planning interview. The computer model is based on recordings of the counselor's verbalizations in two situations - as he thought aloud while analyzing the student cumulative records prior to interviews, and as he conversed with the student during the interview. Their sample consisted of 20 ninth-grade students.

A program on the Philco 2000 computer, representing the pre-interview appraisal, accepts such inputs as school grades, test scores and biographical data; analyzes the data according to the inferred model of the counselor's decision-making rules; prints out statements such as "Student's grades have gone down quite a bit. Ask about this in interview. Possibly there are personal problems," or "Low counselling priority; no problems apparent."

The automated interview is conducted by a teletype under control of the Q-32 computer in a time-sharing mode. This automated interview program reviews student progress, collects comments from the student, reacts to student plans, and helps the student plan a schedule of high school courses. To validate the model, the automated systems were compared to the responses of the original human counselor with a new sample of 20 students from the same population. The authors conclude that the automated procedure is useful for both research and field application.

Another approach to computer-assisted counselling is being taken by Ellis (66-1008) at the Harvard University School of Education. This study is concerned with the requirement for information retrieval in vocational counselling.

C. INFORMATION RETRIEVAL

In the early stages of his education, the student and teacher interact in a tight feed-back loop, designed to improve the student's performance according to predetermined criteria for achieving specified behavioral objectives. As the student's education advances, the steps become larger and the objectives and criteria become more general. In taking the large steps, the student may spend more time in a "library mode," searching for relevant material.

When he goes to the library, neither the student nor the librarian may have a very clear idea of the student's objective, or of the criteria for their mutual success in information retrieval (IR). Consequently both the user and the system must be adaptive, working toward a goal which is progressively refined during the search.

Much of the research on computer-assisted IR is on a natural language capability to facilitate interaction between student and computer during the search. Arthur D. Little, Inc. (63-1101) has reported on an associative searching technique which (1) permits the user to employ his own vocabulary in formulating a typewritten request, and (2) allows the machine to find relevant information even when there is no direct matching of vocabulary items. The answers made by the computer are based on the network of associations implicit in the stored message data, and the item output is in order of decreasing relevance to the question.

IBM (62-0501) has also reported some early steps toward a cooperative man-machine system for the high quality, high speed perusal of large document collections. These steps include algorithms for translating the student's English-like sentences into logic-like sentences, efficient techniques for grouping similar texts, high speed automatic dictionary look-up procedures, and the construction of computer programs for constructing representative abstracts and index terms.

Kessler (65-0307) has described a working model of a technical IR system in use at MIT. It involves the literature of 21 journals in the field of physics. Remote consoles give the student access to a time-sharing computer facility. Programs have been developed for a variety of search techniques based on key words, KWIC index, citation index, bibliographic coupling, author, location, or combinations of these. The computer responses may be in real time or delayed. A teaching program in the computer teaches the student how to use the system.

III. MAJOR CAI CENTERS

Operating CAI systems can be classified in four categories:

1. Dedicated systems.
2. Systems with a collateral CAI capability. These are found primarily in industry and the military establishment.
3. Public utilities accessed by institutions for instructional purposes.
4. Small special-purpose computers, serving only one student at a time.

A. DEDICATED SYSTEMS

1. IBM Yorktown

IBM's Watson Research Center in Yorktown has been conducting experimentation with CAI. Programs will be developed for students ranging "from kindergarten through graduate school" (65-0406). Florida State University (65-0406), Pennsylvania State University (65-0408), and Columbia University (65-0705) are among the institutions that have been linked to IBM computers at Yorktown. At the American Management Association conference on educational technology (65-0910), segments of courses in statistics, American History, English, bridge, number squaring and cubing, spelling, and reading were presented daily.

E. N. Adams of IBM Yorktown has discussed the "Roles of the Electronic Computer in University Instruction" (65-1011). Also, he has more recently written a research report on a computer-controlled language laboratory (66-0310). Other research reports from the IBM Yorktown staff include H. W. Morrison's paper on "Computer Processing of Responses in Verbal Training" (64-0206) and E. M. Quinn's classification of content independent Coursewriter programs which are economical in terms of preparation and computer storage (65-0917).

2. IBM Poughkeepsie

IBM publications from Poughkeepsie deal with the Coursewriter program for the IBM 1401/1440/1460-1026 and 1440-1448 data processing systems (64-0001, 65-0505) and the IBM 1800 data acquisition and control system (65-008).

From the IBM Poughkeepsie computer, a pilot study was initiated in the industrial training of employees at IBM offices in Philadelphia, Los Angeles, San Francisco, and Washington, D. C.; the students were IBM customer engineers (65-1002, 65-0803).

3. IBM Los Gatos

Experimentation based on an IBM system 1500.

4. University of California/Irvine

CAI is being explored at the new Irvine campus of the University of California (UC/I), which, under a joint research agreement with IBM, will become a computer laboratory for investigating all the ways in which the computer can aid educational institutions (65-0910). UC/I was the site of a Conference on the Uses of the Computer in Undergraduate Physics Instruction (65-1110), which included discussion of curricular-administrative problems, pedagogical techniques, systems, and equipment.

5. University of California/Santa Barbara

This is the center of the Culler-Fried "computer-based blackboard" system, connected also with the Harvard Computation Center. The display is a CRT with a memory. Using a keyboard in the classroom, the instructor can cause the computer to generate a graphic display on the CRT of simple or complex functions, as well as symbols (66-0304).

6. Dartmouth College

Dartmouth College is the site of an evolving time-sharing system which has been in operation for over two years (65-0903). GE 235 and now 635 computers with the Data-Net 30 are used. Terminals are 20 teletypes installed in dormitories and at other locations. When the system was first put into operation, only one algebraic compiler, BASIC, was available. Subsequent additions have included the following: TEACH, a system which allows an instructor to code BASIC programs to analyze the results of a student program while the student's progress is running; a fairly complete version of AGOL 60; a machine-language interpretive program called DIP; a program maintenance system called EDIT. There is a manual for BASIC (66-0101).

Numerous New England schools have accessed the Dartmouth time-shared computer, among them Phillips Exeter Academy (65-0904). A central library of useful programs has been established; it now contains 16 categories. In each category, there are a dozen to two dozen routines (66-0415).

7. MIT MAC

One of the early projects of MIT's Project MAC was a computer program for semantic information retrieval (64-0604). Further experience with MAC (Multiple-Access Computer) suggested some significant new transmission and terminal equipment requirements (65-0011). MIT's Project MAC is wide in scope; research has been done on slave memories and dynamic storage allocation (65-0405). R. C. Rosenberg wrote a thesis on the subject of Computer-Aided Teaching of Dynamic System Behavior (65-0913). A recent MAC Progress Report is (65-0708).

8. System Development Corporation

SDC has a broad program in computer-assisted education. Specific projects include an author language, PLANIT (66-0703), and computer-assisted counselling (65-0804). The Q-32 computer has been replaced by an IBM 360/50I which in turn will give way to a dual 360/67. The entire program is summarized in the proceedings of an ONR-sponsored meeting of the CAI interest group at SDC in September 1966 (66-0909).

9. AF Electronic Systems Division

COBIS (Computer-Based Instruction System) at the Electronic Systems Division, Hanscom Air Force Base, Bedford, Mass. has three principal features: (1) a light-pencil is used in a multiple-choice format, (2) the student indicates his degree of certainty on a CRT screen, (3) the computer considers both the student's answers and his degrees of certainty when branching to remedial sequences or further steps and a special scoring system has been developed for this purpose (Baker, 65-0301).

10. Bolt, Beranek and Newman, Inc.

Early consideration of an application of a computer as a teaching machine was presented by Swets et al in <u>Learning to Identify Nonverbal Sounds</u> (62-0601). Subsequently, Feurzeig et al, in a technical report, discussed <u>The Socratic System: A Computer System for Automated Instruction</u> (63-1001). Feurzeig's research activity, oftentimes in collaboration, from 1963-1965 resulted in reports such as the following: <u>The PDP-1 Computer as a Teaching Aid in Problem-Solving</u> (64-0004), <u>The Computer That Talks like a Teacher</u> (64-0503), <u>A Conversational Teaching Machine</u> (64-0601), <u>A Computer System to Aid in Teaching Complex Concepts</u> (64-0803, 64-0804, 64-1205), <u>Computer-Aided</u>

Teaching in Medical Diagnosis (64-0805), The Computer as an Educator (64-0904), A Computer Language for Programmed Discourse (65-0007), Towards More Versatile Teaching Machines (65-0302), Computer-Aided Instruction (65-1001). Other BBN research activity is treated in R. H. Bolt's Computer-Assisted Socratic Instruction (65-0703), and Overview of Potentials of CAI (65-0707).

11. Pennsylvania State University

With a $97,000 grant from the U.S. Office of Education, faculty members at Pennsylvania State University are preparing the following courses to be offered for credit at the University: modern mathematics, speech pathology and audiology, cost accounting, and engineering economics (65-0408, 66-0408). Results on student reactions to CAI have been documented (65-0902, 65-1207).

Research in CAI is continuing; work is presently being conducted by telephone lines to an IBM 1410 at the Penn. State Computation Center and a 7010 at the IBM Research Center in Yorktown Heights, New York.

Other equipment at the Computation Center includes an IBM System 360 Models 50 and 20, a 7074, and a 1401. A System 360 Model 67 is on order to replace the Model 50.

12. SOCRATES

The SOCRATES research at the Training Research Laboratory, University of Illinois, has two basic goals: (1) to build a psychological model of instruction and (2) to determine the requirements for effective computer teaching systems (64-0602). The first SOCRATES student-interface was put on-line in May 1964 (64-1101). The SOCRATES system, which is adaptive in three ways, uses an external (disc) memory with a capacity of 2 million digits as its library (65-0701). With especial reference to SOCRATES, Stolurow discussed the systems approach to instruction (65-0704). There is a listing of SOCRATES research studies from March 1964 to June 1965 (65-0912).

A 1966 report describes the initial steps to make AUTHOR operational with SOCRATES (66-0202).

SOCRATES II (the system configuration with the 1620/1710, the 1311 disc, and the MASTER I/O student station) is operative, and its precise status is summarized in 66-0302.

13. Harvard Computation Laboratory

The direct objective of the Project TACT is to enable the natural and effective use of a computer as an animated blackboard by a lecturer, and as an aid in classroom exercises and homework assignments by his students. Oettinger visualizes the application of the projected system to a class in the calculus. The project has since been implemented for the calculus, population, genetics and statistics, using the Culler-Fried system based at the University of California/Santa Barbara computer (66-0304).

Harvard has on order an IBM System 1500 for use at the Medical School in April 1967.

14. University of Illinois, Coordinated Science Laboratory

To date, 120 programs have been written for the PLATO system at the Univ. of Illinois - Coordinated Science Laboratory. The programs employ several teaching logics; principal examples being the "tutorial" or "inquiry" logics. Some PLATO I and PLATO II lessons are unavailable for use on the PLATO III system (65-0702).

PLATO III system equipment, with 20 student stations connected to a CDC 1604 computer, and present research on a plasma discharge tube has been described in 64-0406, 65-1008, and 66-0709. PLATO IV, which includes an audio facility, is now under construction (66-0709).

Zinn has used his own criteria to rate his experience with PLATO (66-0405).

15. Florida State University

Florida State University is linked to IBM's Watson Research Center in Yorktown, New York. Subject matter being developed includes: solution of trigonometric identities, educational measurement, non-matric geometry, learning paired-associates, test validity, and stress and strain tensions (65-0406).

16. University of Texas

The Laboratory for Computer-Assisted Instruction at the University of Texas opened in September 1965. An IBM 1401-1026 system became operational in February 1966. There are 33 course development projects underway, and statistics on system utilization are available (66-0608).

17. Board of Cooperative Educational Services (BOCES) of Northern Westchester County (NY)

This project evolved from work between IBM (Advanced Systems Development Division) and schools in Northern Westchester County. Remote access to IBM 7090 and 1401 computer systems via 1050 terminals. The project is oriented mainly toward simulation as a method of providing individualized instruction in economics, although other programs are in development for other subject matters (66-0607, 66-0606, 65-0202, 65-0012).

18. University of Pittsburgh

The Learning Research and Development Center at the University of Pittsburgh is described in a general report covering the five major projects (Individually Prescribed Instruction, Computer-Assisted Instruction, Curriculum Design, SUCCEED, Responsive Environments) and the exploratory research areas (Learning Laboratories, Measurement and Decision Processes, and Educational Sociology 66-0410).

19. Stanford

Atkinson and Hansen (66-0305) and Suppes (66-0702) and Suppes (65-0104) describe in detail the equipment used in the Stanford Computer-Based Laboratory for Learning and Teaching (Stanford I), outlines the work which has been done on the programs for grades 1, 4, and 6, and describes the program logic to be used on the computer. Equipment description includes optical display unit, CRT, typewriter keyboard, audio system, central computer. The Stanford Reading Curriculum is described in (66-0811).

20. Westinghouse

Westinghouse Electric Corporation (65-0010) is developing a computer-based educational system, centered about six areas of effort: hardware development, computer programming, educational materials preparation, student motivation planning, teacher role determination, and administrative implementation development. The heart of the system is the control computer and the student consoles, designated as SLATE. The Behavioral Technology Department, located in Albuquerque, N. M., is particularly concerned with development of computer-based educational material, student motivation planning, and teacher role determination.

B. PUBLIC UTILITIES

1. General Electric Time-Sharing Service

Eight locations. Remote access by Model 33 or 35 Teletypewriter. BASIC, Dartmouth ALGOL, FORTRAN and other languages. $350/mo. up to 25 terminal hours and 2 CPU hours. Programs may be stored in the system.

2. Bolt, Beranek and Newman, Inc. /TELCOMP

One location (Cambridge) with a second scheduled (New York City). Remote access by Model 33 or 35 Teletypewriters. TELCOMP, GAUSS and other languages. Hourly rates: $15 per hour up to 20 terminal hours. $12 per hour after. No system storage.

C. SMALL SPECIAL-PURPOSE SYSTEMS

1. Edison Responsive Environment

Ten "talking" typewriters have been installed in Brooklyn and 13 in Chicago with a grant from the Office of Economic Opportunity. The machine manufactured by McGraw-Edison and distributed by Responsive Environments Inc., Englewood Cliffs, N. J., is especially useful for teaching language arts at the pre-school and primary grade levels. Success has also been reported in therapeutic treatment of autistic children. Supervisors are trained by the Responsive Environments Foundation at Hamden, Connecticut.

IV. CAI SYSTEMS STUDIES

A. SYSTEMS ANALYSIS

As in other applications of computer technology, there is an understandable tendency on the part of educators and manufacturers to build instructional systems around available hardware and software. "State-of-the-art" systems, however, often distract investigators from a proper search for an optimum learning environment or instruction system configuration. Happily there are some workers who have time for speculation on total system design.

For those who may lose sight of the woods for the trees, Eckstrand (64-0903) has identified three steps in the design of a training system: (1) setting training requirements, (2) designing the training environment, and (3) designing evaluation techniques. He describes each step in helpful detail.

In a monograph on an information systems approach to education, Ryans (63-0903) has described a teaching model which emphasizes three characteristics of teaching-learning: (1) the interdependence and interrelatedness of conditions influencing teaching-learning, (2) the importance of information processing in the description of teaching behavior and pupil learning behavior, and (3) the basic information-conveying nature of instruction. Some aspects of the model are illustrated with the obsolete CLASS system at the System Development Corporation.

Fuerzeig (64-0904), considering "the computer as an educator," classifies computer-based instruction in four categories: computer-controlled systems, student-controlled systems, collaboratively-controlled systems, and teacher-controlled systems. He cites specific examples of systems that fall into each category.

Bitzer, Lyman, and Easley (65-1005) compare the merits of a large central system, such as PLATO, with smaller local systems, such as SAKI or the McGraw-Edison Responsive Environment. The use of a high-speed digital computer as a central control element provides great flexibility in an automatic teaching system. Using a computer-based system permits versatility in teaching logics since changing the type of teacher merely requires changing the computer program not the hardware. In addition, having access to the decision-making capacity of a large computer located as one unit, permits complicated decisions to be made for each student. Such capacity would be prohibitively expensive to provide by means of decision-making equipment located at each student station. The results of exploratory queuing studies show that a large system could teach as many as a thousand students simultaneously without incurring noticeable delay for any student's request.

Pask (63-0005) surveyed work on learning (as opposed to teaching) machines up to the middle of 1963. The emphasis was on conditional probability machines and an attempt was made to relate learning machines to man/machine interaction and adaptively controlled teaching systems. In more recent papers Pask (65-0015, 65-0016, 65-0105) and Lewis and Pask (65-0017) have examined teaching machines as systems in which a human subject interacts with an adaptive control mechanism. Abstract, cybernetic models are discussed, together with supporting experimental data. The discussions cover equipment, teaching logic, learning models, and applications to other, non-academic environments.

B. TIME-SHARING

It is undoubtedly the increased availability of computer time-sharing software and hardware which has sparked the widespread interest in CAI in the past year. Many reports contain a reference to time-sharing, although most systems have reached a point of development when the non-technical user can take the time-sharing capability for granted. Several companies, including General Electric and Bolt, Beranek and Newman, Inc., now offer on-line, time-shared computer services adaptable to instruction. The user with a teletypewriter (Model 33) (63-0007) and a General Electric (66-0808) or TELCOMP (66-0504) user manual can access either system remotely.

Project MAC has pioneered the utilization of time-shared equipment. Based on his experience with project MAC, Mills (65-0005) suggests some new transmission and terminal equipment requirements, e.g. a general purpose terminal, perhaps with keyboard input and visual display output. He believes transmission requirements for time-shared multiple-access systems probably cannot be met by straightforward extensions of services now available through common carriers.

The Massachusetts Board of Education (Richardson, 64-1207, 65-1106) has established a project to answer three questions about time-sharing: How can a time-shared computer be programmed to act as a useful tool for teaching mathematics? (2) How can teachers be taught the necessary techniques to use it? (3) How can a time-sharing system be made economically feasible? The study is being conducted in several schools in suburban Boston. Students in grades 6, 9, and 11 use a time-shared PDP-1 computer at Bolt, Beranek and Newman as a mathematical laboratory. The investigators anticipated several benefits from a time-sharing system: (1) The student will have the feeling of working on his own computer. (2) Having a computer on an "always ready" basis will encourage students to

engage in extracurricular use of the computer. (3) Students will achieve a more thorough grounding in basic concepts of mathematics.

The PLATO system at the University of Illinois Coordinated Science Laboratories was expanded to ten stations early in 1965 (CSL, 65-1008). In a corresponding improvement in software, a new tutorial logic was developed which allows authors to enter parameters from any student station while other stations are in use.

C. STUDENT VARIABLES

The student, like the instructor, the central processing unit, the terminal, and the software, is a component in the instructional system. Consequently, system studies should take into consideration student variables ranging from motivation to perception. Suppes (64-0306), for example, is emphatic about the importance of careful attention to individual difference variables in planning CAI systems. He reports that, when freed from a lock-step instructional procedure, the fastest child in a first grade mathematics program achieved 50 p. c. more than the slowest; the fastest child in a kindergarten required 196 trials on a reading experiment, the slowest 2506 trials; and rate was not strongly correlated with I. Q.

Individual differences of college students, including reaction to computer-assisted instruction, have been measured in four CAI courses offered at Penn State (66-0408).

Lubin (60-1207) has investigated the effect of individual differences in scholastic aptitude and the student's need for autonomy in a programmed psychology course. The group with a low autonomy-need scored higher than subjects with a high autonomy-need.

It is commonly observed that some students are agressive in their interaction with the instructor while others are more deferential. Given the opportunity, a teacher usually adapts his stimulus and reinforcement style to this student characteristic. Stolurow (65-0604) would have a CAI system adapt to individual differences in this personality characteristic as well. He further recommends personality research to develop appropriate reinforcers for use in CAI.

Computer-assisted instruction itself provides a means of studying individual differences, especially variables related to response contingencies (Davis and Stolurow, 64-1106).

D. ANSWER-PROCESSING

A constructed response CAI system matches the student's response against stored performance criteria. Often inaccuracies in the student's response are irrelevant with respect to the performance criteria, but nevertheless impede the matching operation. Answer-processing routines eliminate irrelevant errors. For example, Bolt. Beranek and Newman (64-1205) has developed an algorithm called "Soundex encoding" which automatically recognizes and corrects common spelling errors in the students' responses. At a conference on CAI language (Newton, 66-0304), IBM cited several answer-processing features that have been or are being developed for COURSEWRITER. One technique is to count the number of correct characters (or other units) in a response and divide this by the total number of units in a correct answer. If this exceeds some pre-set ratio, the answer is counted as correct. Numerical answers that fall in a prescribed range are accepted as correct.

E. ARTIFICIAL INTELLIGENCE

The success of CAI depends on the development of computers that teach. On the other side of the coin, researchers are trying to create computers that learn and/or recognize patterns. While there is no immediate interaction between research on CAI and artificial intelligence, it is reasonable to expect some benefit to CAI in the future The benefits may come from a computer model of the learner, or they may come in the improved computer implementation of pattern recognition, an important requirement in matching the student response with stored criteria.

Choissor and Sammon (63-0502) advanced a new concept in artificial intelligence by constructing CHILD (Cognitive Hybrid Intelligent Learning Device), a self-adaptive learning machine. Choissor and Sammon view adaptive learning devices as networks of redundant adaptive elements which are capable of being organized by some learning logic. The common function performed by the learning machines considered, consist basically of a remapping of the sensory space in some manner which will enable decision elements to divide the remapped sensory inputs into various classes.

The "fungus-eater" games designed by Nakahara and Toda (64-0204) yield a class of realistic tasks. The comparison of human strategies with the optimal strategies for these games improves our understanding of complex dynamic decision tasks. In their paper the authors derive the optimal strategy for the fourth fungus-eater game, which depends upon the level of fungus storage, and describe the behavior of humans playing the game.

Vossler and Uhr (62-0803) have designed and tested a pattern recognition program for its ability to learn to recognize handprinted and handwritten letters, Arabic handwriting, cartoon faces, photographs, abstract shapes, and degraded speech. A second program, when presented sentences in two different languages, attempts to discover and develop its own translation procedures. They discuss the model as a method for studying and automating processes of discovery and induction of the sort that seem to be needed in the development of thinking organisms. In a later, more comprehensive paper Uhr (63-0105) reviews computer simulations of pattern recognition to show their relevance as models of form perception.

F. CENTRAL PROCESSING UNITS

Only a few papers trace the procedure by which specifications were set and computers selected for particular systems. Beginning with a consideration of the capabilities of a particular computer (CSX-1), Bobotek (62-0003) analyzed the restrictions storage in the CSX would impose on the number and length of lesson programs and the number of students served by the PLATO II system at the University of Illinois. Bitzer and Easley (64-0406) traced the evolution of PLATO I, II, and III, based successively on the ILLIAC, CSX-1 and CDC 1604 computers.

Anderson and Ewing compared digital systems for their usefulness in research in training simulation techniques (64-0506). They recommended the Packard-Bell 440 and SDS 9300 for their high computation rates in real-time applications.

G. STORAGE

The computer used as the control element may limit the capacity of the system either by the amount of available storage or by the speed of its operations. To Bobotek (62-0003) the limitations due to speed, however, do not appear to be significant for a system serving less than 1000 students; the restrictions imposed by storage seem most important.

Early papers by Lichtenberger, Bitzer and Braunfeld (62-0001) and Bobotek (62-0003) describe the storage problems of the PLATO II system when confronted by requirements of the flexible PLATO teaching programs. The first computer employed in PLATO II was ILLIAC, a medium-speed digital computer with high speed memory of 1,024 words. Because of this limited memory capacity, PLATO II could be used to instruct only two students, though the program was written to handle more. To stretch the memory, textual information stored on slides was displayed to the student electronically on a television screen.

Research in the development of memory units has tended towards qualitative changes in memory. Several developments, both in hardware and software, seem promising for CAI. These include vocabulary compressions, slave memories, special storage languages such as FLEX and LUCID, and associative networks. The SOCRATIC system uses 18-1 vocabulary compression to save memory space (Feurzeig, 64-0804). Wilkes (65-0405) proposes a fast core memory of, say, 32,000 words as a slave to a slower core memory of, say, one million words in such a way that in practical cases the effective access time is nearer that of the fast memory than that of the slow memory.

In an information retrieval system, the Magnacard system can be used to store large files of inventory information. It consists of a bank of filing cabinet drawers containing oxide coated cards, each one inch by three inches, which can be read from the written onto by magnetic heads similar to those found in tape recorders. Access to the stored information is provided through a mechanism which can remove a drawer from the bank, read from or write onto the cards in that drawer, and return the drawer to the bank. Leifer (64-0106) discusses the organization of the inventory file within the drawers in order to optimize the retrieval time for a given number of interrogations of the file.

Under the title Automatic Language Analysis, research has been directed towards the development of a device which would process and store completely unedited English language texts and print out answers to questions regarding these texts presented to it in their natural language form (Thorne, 62-1201). The approach followed requires that the computer itself syntactically analyze input text in order to convert it into a special form called FLEX, which preserves only that syntactic information which is useful for data retrieval purposes. In their FLEX forms, sentences can be compared to determine the degree of their relationship to each other in respect to both word meaning and propositional meaning. A high correlation between a text sentence and a question indicates that the text sentence is a relevant answer.

H. I/O EQUIPMENT

Barmack and Sinaiko (66-0409) review current practices in computer-generated graphic displays from the point of view of engineering psychology. Input devices which are integral with CAI systems are also considered. Theories of cognition are examined with respect to their applicability to computer-graphics.

V. LANGUAGES

A. STUDENT LANGUAGES

1. TELCOMP

A number of recent developments in CAI software were demonstrated or described at an ONR-sponsored conference held in Cambridge in March (Newton 66-0304). At the March meeting Bolt, Beranek and Newman demonstrated computer programs written by high school students in the Boston area using the TELCOMP language, a dialect of JOSS. The programs were written by the students as a part of a project sponsored by the Massachusetts Board of Education to evaluate the time-sharing computer as a "mathematics laboratory" (Richardson, 64-1207, 65-1106). TELCOMP, the language used in this application is a good example of a student language (66-0504) as is BASIC, the language developed at Dartmouth for student use and now widely used on the General Electric time-sharing service (66-0503).

2. BASIC

BASIC is an elementary algebraic language and as such is not suitable for building constructed response programs (Newton 66-0304). It is possible, however, to imitate multiple choice teaching machines. BASIC, which is very much like JOSS, is described in two similar manuals (Kemeny, et al, 66-0101;66-0503). Each includes a primer on BASIC, advanced BASIC, and Card BASIC. Appendices list error messages, limitations on BASIC, and the 15 BASIC statements.

B. TEACHER LANGUAGES

1. COURSEWRITER

At the same Cambridge conference, Morrison described the announced and experimental versions of COURSEWRITER, the IBM-developed language by which teachers formulate the branching program which guides the student through a given subject matter (Newton 66-0304; IBM, 64-0001). Maher (64-0307) had earlier reviewed the genesis of COURSEWRITER and the associated interpretive computer program. Morrison listed the following goals for COURSEWRITER: (1) the key figure is the subject matter expert, who probably is not familiar with computers; (2) the language should be high level, i.e. powerful; (3) a high degree of flexibility in pedagogical logic should be allowed; (4) revision of an instructional program should be easy.

Morrison described the pedagogical logic inherent in the announced version of the COURSEWRITER language, then went on to describe the extensions made in the experimental version of COURSEWRITER developed on the IBM 7010 system. For example, in one extension the teacher may show or withhold a slide or an audio message as a function of the current value on one of several counters. Time limits for a response may be specified. Students may record an audio message and play it back later, a feature which will facilitate the use of COURSEWRITER in a language laboratory context. Considerable work has also been done on response-processing. Several functional modifications of exact match tests have been developed (see also Response Processing).

A calculation mode called MAT is in development.

2. AUTHOR

AUTHOR is another "teacher language" discussed at the Cambridge meeting (Newton 66-0304). As described by Stolurow and Lippert (66-0202), AUTHOR also has an inherent pedagogical logic which the instructor must use in formulating the program to be followed by the student. AUTHOR I is written in SPS II-D. The instructor uses the console typewriter of the 1620 or the card punch (Stolurow et al, 66-0302).

3. MENTOR

MENTOR is a language or pedagogical logic devised by Bolt, Beranek and Newman. The authors call it a Socratic logic, but it might be more meaningfully classified as a computerized case method of teaching. It has been used to exercise medical students in medical diagnosis (Feurzeig, 64-0805), business students in management decision-making, and anybody who's interested in the solution of a homicide (P66-0301).

MENTOR is embedded in the list processing language LISP and is essentially verbal rather than computational. Before the study session begins, the student is given a list specifying the vocabulary for the problem. The student's questions and declarations must be chosen from terms on this list, which may be extensive. The student can specify to the computer the information he wants when he wants it, and he can make assertions as to the solution whenever he wishes. The responses by the computer at any time are determined by the student's knowledge at that time; not only what has been said, but everything that has gone on before. The pedagogic strategies are open; they are a part of the information specified by the instructor who prepares the problem. Contingencies may be developed to an arbitrary depth. The problem may involve a situation which changes

with time Output strings are prestored, rather than generated by the system. The sophistication of MENTOR discourse compared to the simple tutorial systems is based on its facilities for describing history-sensitive and context-sensitive interactions

An article by Feurzeig and Bobrow (65-0007) discusses the construction of a discourse and gives the reader an intuitive feeling for the structure of the MENTOR language. On a broad scale, the subject matter specialist begins with a preconceived model of his problem, including the strategies he wants to employ to govern the interaction. He then proceeds to elaborate a particular context by choosing the key conditions: a factorization of all possible inputs within that context. He then fills out the associated conditional expressions to encode the interaction history he considers as significant. The instructor's major task is that of conceiving a model of his problem. The task of expressing his problem as a programmed discourse has been reduced to a relatively straightforward procedure.

The system was programmed for the PDP-1, but can be used with other computers, including the smaller and slower types (Feurzeig, et al, 64-0805).

MENTOR applications include, in principle, any analytic situation in which the user can specify responses on all possible branching paths through an interaction.

4. PLANIT

An important recent development in the language area is the introduction of PLANIT, the teacher-oriented language devised at the System Development Corporation (Newton, 66-0304; Feingold, 66-0204). PLANIT was developed on the ANP Q-32 computer, but is being moved to the IBM 360 Mod. 50I and later will be adapted to a dual 360/67. PLANIT is a teacher-oriented language with an inherent logic comparable to COURSEWRITER. The basic approach is to look at a lesson as a sequence of units. PLANIT also has a calculation (calc) mode.

The language is oriented around frames, of which there are five types: problem, question, multiple choice, decision and copy. Having selected the type of frame, the lesson designer is then led through a series of steps by the machine: label frame, specify question, specify answers, specify actions (Feingold, 66-0204, Feingold and Frye, 66-0703).

PLANIT includes statistical functions and a mathematical capability which allows an instructor to present problems, generate sample data for those problems, and to query and evaluate the student's response in terms

of the samples generated and the statistical routines which operate on them. Provision is made for decision branching, recording and course editing. The calc mode of PLANIT by itself can be used as a highly sophisticated calculator for defining and evaluating mathematical functions.

PLANIT also provides answer-processing functions for evaluating student answers that depart from the expected response by making PHONETIC comparison, KEYWORD match, equivalent algebraic matching, etc. It also allows one lesson to call another, and any program (or subroutine) written in JOVIAL can be added to the lesson and executed at any time. Feingold and Frye have written a User's Guide to PLANIT (66-0703).

C. COMPILERS

1. CATO

CATO is the compiler used with the University of Illinois Coordinated Science Lab PLATO system. While it is a teacher-oriented language, as a compiler CATO has no single pedagogical logic but has been used to implement several kinds of interaction between student and computer. The major categories of interaction are tutorial and inquiry logics.

CSL has conducted summer workshops for elementary school teachers to acquaint them with the PLATO inquiry logic (CSL, 65-0407). A short program, using a semi-automatic audio system has been used to test the feasibility of teaching young children the letters of the alphabet. A program called TEXT-TESTER, designed to test new textbooks, is available on PLATO (65-0407), and has been used to test a remedial arithmetic text with nine students (65-1008).

2. COMPUTEST

COMPUTEST is a problem-oriented programming language for computer-assisted instruction, testing and interviewing using the IBM 1620, Model 1. Sequences of instructional material and test questions may be written in natural language and a variety of cues may be used for the recognition of the right answer from typewriter input. Variable comments and choice of the next question to be asked may be determined by the evaluation of an answer. Scoring and data collection is optional for each question. COMPUTEST acts as an interpretive translator of program material which is present in the card reader and in the course of typewriter interaction with a subject. Typewriter input is limited to a maximum of 477 characters including blanks (Starkweather, 65-0712, 66-0501).

3. TMCOMPILE

In an excellent article, Uhr (65-0005) describes a set of two programs (TMCOMPILE and TEACH) which (1) allow someone to write a program in his content area without having to learn anything new other than what is proposed as an acceptable minimum of conventions, and compile it (TMCOMPILE); and (2) interpret the compiled program, thus giving a running program that interacts with students (TEACH). This compiler-interpreter permits programs to be written in relatively unconstrained natural language. It is coded in SNOBOL for the IBM 7090. The type of text that the author must write are sets of strings which are either statements (of information) or questions. The questions must be followed by alternate possible answers, and each set of alternate answers must be followed by an explicit or implied branch to another string in the text.

The Cambridge conference on CAI languages included a general discussion of languages monitored by Leonard Uhr that brought out a number of interesting comparisons between COURSEWRITER, PLANIT, TMCOMPILE and other languages (Newton, 66-0304). Uhr proposed that all languages could be compared by reference to a simple question and answer model. Licklider felt that such a model was too simple to encompass all possible uses of the computer in instruction. Criteria proposed and defined for CAI languages included: elegance, power (efficiency), generality (capability), reliability, convenience in learning, using, and changing, and level (Zinn, 66-0405).

VI. INSTRUCTIONAL THEORY

In this section the authors review (1) experimental studies of learning which seem to have a rather direct application to CAI, such as the learning of paired associates, (2) analyses of instructional logics on which various systems are based, (3) theoretical and experimental studies of optimal learning sequence, (4) adaptivity and (5) frame construction.

A. STUDIES OF LEARNING

Davis and Stolurow (64-1106) point out that programmed instruction has helped the study of learning by focusing attention on individual differences among learners. They contend CAI will contribute to experiments in basic learning by permitting the study of variables relating to response contingencies that cannot be studied any other way. They cite a number of research studies conducted with the SOCRATES system.

In a valuable article, Suppes (64-0306) reviews (1) the implications in recent research in learning theory for the elementary school curriculum and (2) the use of computer technology to realize these implications. He summarizes experimental studies showing the importance of both immediate reinforcement and overt correction in children's learning. He reviews experiments on optimal block size in learning a list of simple (e.g. vocabulary) items, and on response latency as a criterion of learning. He concludes that in reading, mathematics, and foreign language, response latencies are more sensitive measures than response errors.

Mirabella and Lamb (66-0306) conducted three experiments to explore the effects of adaptive vs. nonadaptive training upon performance in a visual target detection task involving symbolic displays. Their results indicate that increasing display complexity during training and requiring subjects to respond actively to the displays was more effective than maintaining a constant level of complexity and requiring only passive viewing of the displays. But there was no evidence to suggest that changing complexity in an adaptive fashion was more effective than changing complexity in an arbitrary step-wise fashion. Additional findings indicated that maintaining subjects at a high nominal error rate during training was not necessarily detrimental to post-training performance. A high error rate was at least as effective as a low rate, where the high rate was reached by increasing error rate in a step-wise fashion.

Stolurow (64-0402) thought it likely that particular programmed instruction sequences generate learning patterns corresponding to traditional concepts of learning theory. In one study he sought to determine whether an undesirable learning pattern generated by a program was one of proactive inhibition or learning set.

B. INSTRUCTIONAL LOGICS

1. Introduction

The rules governing the interaction between student and computer comprise an instructional or pedagogical logic. Since the rules are mediated by the language and implemented by the hardware system, logic, language and system are closely interrelated.

The principal categories of instructional logic are:

(1) Tutorial
- (a) Linear
- (b) Intrinsic
- (c) Adaptive

(2) Socratic

(3) Laboratory (or Simulation)

(4) Game

These categories are not easily separable operationally. In simplest terms the tutorial logics follow a prescribed question-and-answer pattern. In a linear program, all students negotiate the same pattern. The only individualization is in rate of completion.

In an intrinsic logic, each stimulus presentation, or stimulus subroutine, is determined by the student's immediately preceding response. In an adaptive logic, the choice of each stimulus is predicated, not just on the single, immediately preceding response, but on a series of responses or prior behavior. Some of the a priori information may in fact be entered as data from aptitude, personality and achievement tests.

Intrinsic and adaptive programs require the computer to make many successive decisions, choosing among instructional alternatives as a function of the student behavior during or before he entered the program. The decision-making models are quite simple at present, but more sophisticated procedures are being evaluated and are described later in the review (Shuford, 65-501, 66-002).

The Socratic logic (Feurzeig, 63-1001, 64-803, 64-601, 64-904, 65-007) goes beyond the tutorial logics by allowing the student to assert an answer or solution at any point in the interaction, or to ask for data. The procedure, which generally involves the simulation of a time-dependent process, bears a certain resemblance to the case method of study and to a class of management games referred to as "non-interactive" games. For example, the computer presents time-dependent data on a diseased medical patient, or the dynamics of a business, and at the same time evaluates and comments on the student's efforts at problem-solving.

Simulation is less a logic than a technique. The computer is used to simulate some characteristics of the environment, frequently a laboratory environment. The student simply manipulates this simulated environment much as he would the real one. Simulation is int gral with the Socratic method, and may be combined with other logics. For example, REPLAB (65-1107) simulates the phenomena of a chemistry lab at the same time it guides the behavior of the student following an inquiry logic.

The tutorial, Socratic and laboratory logics are for one student. The game procedure is for more than one. The computer acts as a data bank, desk calculator and referee while two or more students interact. The PLATO system at Illinois is used to implement all four logics or procedures: tutorial, inquiry, laboratory and game. The game application is to inter-national simulation (Guetzkow, 66-0208).

2. Tutorial Logics

According to Suppes, Hansen and Jerman (65-1105), both tutorial and Socratic logics are used at the Stanford Computer-Based Laboratory for Learning and Teaching (Stanford I) to teach arithmetic and reading. Suppes (65-0104) uses flow charts to describe the logic used to teach arithmetic in grades 1, 4, and 6. In grade 1, the program consists of 50 sections, each introducing a new concept followed by problems. The number of problems varies considerably from one concept to another. A criterion of successive-number-correct has been set for each section. A student who fails to meet criterion goes to remedial branch.

In grade 4, the "main line" consists of the introduction, the concept, sample problems, and exercises. Cues are given after an erroneous response. A further error leads to remedial branch. Skip branching is used with the bright student.

Suppes, Jerman, and Groen (65-1101) describe the Stanford grade 4 arithmetic program in more detail. It supplements the teacher's daily instruction by reviewing and teaching basic number facts. In the evaluation, machine instruction ran for 7 weeks (N=41, av. I.Q. = 130). Each drill was 3-6 minutes on an average of 20 problems. A correct response to each problem was reinforced by appearance of next problem; an incorrect response was followed by "wrong." A second incorrect response was followed by a repeat of the problem with the correct answer, etc. Ten seconds were allowed for each problem. The student received a print-out of total errors, problems missed, and total elapsed time. At end of the day, the teacher received (1) number of students who made "time-outs" or errors on each problem, (2) the distribution of errors for the class, and (3) the distribution of the total elapsed time.

Hansen, Atkinson, and Wilson (66-0303) have compiled an illustrative lesson for initial reading. This illustrative lesson includes instructional material covering (1) letter discrimination, (2) vocabulary acquisition, (3) decoding problems, (4) syntactic and intonation practice with phrases, and (5) syntactic and semantic practice with word, phrase, and sentence materials. The illustrative reading lesson, intended for the Stanford IBM 1500 CAI system, includes instructional format and execution statements. These involve the specifications of problem for instructions, op. codes, counters, switches, return registers, buffers, branching structures, etc. The lesson gives the reader an idea of the richness of the decision structures being utilized by the Stanford Initial Reading Project.

COMPUTEST (Starkweather, 65-0712, 66-0501), a language for the IBM 1620, follows a tutorial strategy.

3. Socratic Logics

Swets and Feurzeig (65-1001) describe MENTOR in which the computer engages the student in "conversation" while he attempts to solve the problem that is posed. The student types a question or an assertion, and the computer responds by typing an answer or comment or, possibly, a question in return. Limited only by a specified vocabulary on a list given him, which can be extensive, the student can request information or propose a solution whenever he likes. The computer responds in natural English; the response is determined by the student's actions up to that time and by the information he has at that point, and may depend not only on all the previous interchanges but also on their order. The subject-matter specialist and the computer programmer devise conditional strategies so that the computer answers good questions, reproves hasty conclusions, acknowledges perceptive decisions, questions the grounds of inference, suggests new approaches, and develops interesting contingencies to the appropriate depth

Swets and Feurzeig recount system-student protocols obtained with programs for a simple guessing game and for medical diagnosis. The student's vocabulary for the medical program consists of 40 questions and 35 declarative statements. Thirty hours were required for the medical doctor and computer programmer to prepare the medical case. An additional 30 hours of computer programming and clerical transcription were needed, plus several hours for editing the English prose. The Socratic System was designed for the PDP-1.

4. Simulation

Aircraft and submarine simulators, like the familiar Link Trainer, were among the first computer-based instruction systems. At first the computer was an analog device which simulated aircraft or ship dynamics and the environment. Only later was the digital computer adapted to this function. In pilot trainers, the instructor, sitting outside the simulator, established performance criteria and monitored and evaluated trainee performance in a ratio of one instructor to one trainee. Typically, none of the instructor's functions were automated or assigned to the computer.

Patricia Knoop (66-0411) describes a digital computer program for the automatic monitoring of human performance during simulated training missions. The computer program, now in its developmental stage, is designed to serve the dual and interdependent purposes of (1) assisting in the analysis and determination of meaningful performance measures and performance criteria and (2) using these criteria to automatically monitor human performance, including performance evaluation (scoring), adaptive task sequencing, and the automatic initiation of simulated system malfunctions for training in emergency procedures. A description is provided of a Criteria Format that aids the user of the automatic monitoring program in defining criteria with variable tolerances for conceivably any aerospace task or mission. Some projections are made about possible uses of the research-oriented automatic monitoring program to (a) vary criteria as the skill level of a particular student increases, (b) hold selected flight variables constant to allow the teaching of isolated skills on a progressive basis, (c) effect "over-learning" of selected skills by controlling the outputs to the cockpit, and (d) aid in debugging simulation programs. A topical flow-chart is provided for the entire automatic monitoring program.

Bitzer, Lyman, and Suchman (65-1107) describe REPLAB, an "ersatz lab." one of the teaching techniques employed in the Illinois Studies in Inquiry Training project. REPLAB, written for use with the PLATO system, was designed to develop inquiry skills and to study inquiry styles of

individual students. A film, showing an event involving a bimetallic strip was presented to the students by means of a computer-activated projector. The students answered questions about the event posed to them via the PLATO "electronic book." Answers to some of the questions could be found by careful observation of the film, others by obtaining further information from results displayed on their "electronic blackboards" by the computer in response to their inquiries in the PLATO experiment laboratory, property laboratory, or condition laboratory. One set of questions in the question sequence tested the students' ability to go beyond the data they had obtained from the computer and formulate theories. The detailed record of the REPLAB student responses provided by the PLATO system gave data for a correlation of variables in the REPLAB lesson with those from pre-tests and post-tests given the students.

The Board of Coperative Educational Services (BOCES) in Northern Westchester County, New York, and IBM have developed a "simulated environment" for teaching economics to elementary school students (Moncreiff, 65-0201). Three economics games have been produced for delivery by IBM 7090 and 1401 computer systems in an experiment with simulation as a method of providing individualized instruction for the sixth grade (Wing, 66-0606). Students seated at IBM 1050 terminals play roles as priest-king in the Sumerian Game, A. I. D. officer in the Sierra Leone Game, and retail store owner in the Free Enterprise Game, make decisions about economic problems, and react to responses from the computer.

The object of the simulated economic environment is to develop in the student (1) an understanding of the processes at work in a developing civilization, and (2) the ability to make decisions regarding multifactored situations, taking account of several conflicting values or goals. For example, when the student assumes the role of a priest-king of a Sumerian city-state in 3500 B. C., the computer, through a remote typewriter terminal, gives him economic conditions and asks for decisions (e. g. How much of this year's grain harvest should be set aside for next year's planting?), as well as introducing new information such as increasing population, natural disasters, or political problems.

As the child masters each of these new situations the computer advances their complexity, introducing such concepts as public works projects, technological innovation, social organization. The student's objective is to make decisions in such a way that the city-state survives a series of natural and man-made crises, that the population grows, and that a high rate of technological innovation is maintained.

The Sierra Leone Development Project game simulates the economic problems of a newly formed African nation (Wing, 65-0202, BOCES, 65-0203). Situations are taken from actual problems that Sierra Leone has faced. The student assumes the role of Second Assistant Affairs Officer, and finally to Chief Affairs Officer. Each position will bring up problems of a broader scope.

An experimental group of 25 sixth graders that played the Sumerian and Sierra Leone games have been compared by means of specially made tests, observational techniques, and depth interviews with a matched control group who studied comparable materials in a conventional classroom situation. Analysis of the data shows a significantly greater gain in understanding of economic principles by the experimental group on the Sumerian Game from pre-test to post-test, a slightly greater but non-significant gain by the controls on the Sierra Leone Game, a great variation among pupils in time required to complete the games, and low positive correlations between gain and reading ability and gain and intelligence. A theoretical analysis of nine possible ways of providing individual variation in mode of playing shows that the game program permitted variation in five.

The BOCES investigations have recently been extended beyond economics to determine how effective a simulated environment methodology could be in providing individualized instruction in art, biology, chemistry, electronics, elementary physics, French, and music. Teachers from Northern Westchester have drafted materials in each of these subjects to be delivered by means of computer terminals with audio and visual display (Wing, 66-0607). A small number of students have tried out the procedures in all sub-projects except electronics through the use of tape recorders and slide or movie projectors with the teacher simulating a computer. Teaching logics employed included branching programs, tutorial logics, lectures and quiz simulations, a simulated laboratory exercise, a coaching routine, an inquiry logic, a language laboratory simulation, and an economics game.

In each project the students learned what they were expected to learn without undue interference from the technical procedures used. It was also evident that the subjects were excited and interested in learning by the simulation technique. The general conclusion was that the exploratory study demonstrated sufficient promise to warrant further experimentation with simulation and with computer-based instruction.

Carter and Silberman (65-0402) and Frye (64-0002) describe an "ersatz laboratory" or simulation procedure in which the student is taught elementary statistics, then uses the computer to learn applications. The student is given problems and not only uses the computer as a desk calculator, but may question the computer -- via a teletype -- if he has difficulty. A

diagnostic routine branches him to remedial material if necessary. An evaluative routine compares the student's final solution with the best solution and provides him feedback.

Rosenberg (65-0913) describes a computer-based dynamic systems laboratory used at the college and graduate level. The laboratory simulates the behavior of linear dynamic systems which are displayed to the student as linear bond graphs. Students using the lab develop an understanding of first- and second-order system behavior by conducting experiments "in the lab."

Maryann Bitzer (63-0004) describes the use of the PLATO system as a laboratory simulator in clinical nursing instruction.

C. SEQUENCE VARIABLES

In a process that involves learning through the presentation of stimulus items in a sequence controlled by a teacher or computer, it is of interest to determine the rules of presentation, i.e. the stimulus presentation strategies, that maximize the expected level of achievement of the students.

In structuring a CAI program the lesson designer must make at least three kinds of decision with respect to sequence: First he must decide in what order to present the concepts and subconcepts of the subject-matter to be learned. Next he must decide whether these concepts are to be presented as rules or examples, or both, and if both, in what sequence. Finally, he must determine the sequence of reinforced and non-reinforced (test) items, including the repetition of reinforced items as review frames. All of these sequence variables have been studied, but not in one comprehensive experiment. Some of the labels applied to different teaching strategies or sequences are "inductive," "deductive," "discovery," "guided-discovery," "trial-and-error," and "rule-example (RULEG)."

1. Dynamic programming solutions

Dear (64-0906) and Dear and Korush (64-1105, 64-1206) discuss the design of optimal presentation strategies or sequences, including solutions by dynamic programming methods. In some cases, Dear finds optimal presentation strategies may be determined analytically, but for many more complicated situations, a "backward induction" algorithm must be developed. Both techniques are illustrated. Dear found solutions for optimal strategies to be prohibitively expensive and suggests that coarser sets of instructional materials be considered.

Matheson (64-0806) also has investigated the optimization of teaching procedures through the use of mathematical models, the typical situation being that of teaching a list of paired-associate items in a fixed number of presentations. Solution is by dynamic programming techniques. Matheson observes that in the usual application of dynamic programming to Markov processes, it is assumed that the state of the Markov process is observable at each step in the process, but this is not true for Markov learning models. The state of the learning model is not directly observable and the observations available depend on the state of the model in a probabilistic manner.

2. Subject structure and concept sequence

The problem of subconcept sequence in programmed and computer-assisted instruction has spurred interest in the structure of the knowledge space. Suppes (64-0306) states that a central problem for further work in mathematical concept formation is the identification of the structure of subconcepts determining the nature of transfer. Gibson (65-0916) also emphasizes the importance to effective teaching of the structure of what is being taught, in her case reading.

Hickey and Newton (64-0103) proposed a multi-dimensional model for the knowledge space and a procedure for transposing the multi-dimensional space into a one-dimensional teaching sequence. Their paper and one by Della-Piana and Eldredge (66-1036) include analyses of an earlier experiment by Gagne and Brown (61-1002) which compared "discovery," "guided-discovery," and "trial-and-error" sequences. Hickey and Newton related Gagne's alternative sequences to "inductive" and "deductive" learning strategies. Della-Piana and Eldredge accounted for the sequences in terms of prompting, fading, and practice. Stolurow (64-901) proposes that instruction be made either inductive or deductive depending on the performance of the student.

Roderburg, Cluck, and Murray (64-1102) agree that computer-directed teaching machines require that the structure be identified for each subject taught. They describe their attempt to find ways in which the computer itself might be employed to simplify the job of program preparation. For each element of information used in the instruction of the subject, the instructor must designate the immediately preceding element (IPE). The computer then establishes higher order precedence relationships and eliminates redundant paths, etc. The precedence relationships between the individual elements of information are illustrated in a graph. Among other things, the precedence graph shows the minimum number of elements required for the understanding of any particular element or set of elements. Thus, if the student fails to comprehend an element, the graph indicates elements to be considered in remediation.

The IPE procedure was applied to Smallwood's adaptive teaching machine program for miniature geometry and to the first chapter of Aitken's Determinants and Matrices. Eleven graduate students were asked to identify the IPE for each element in Aitken's chapter. Precedence graphs were then computer-constructed. There was much variability in the lists of IPE's.

The PLATO program VERBOSE (Hicks, 65-0014) was developed as a first step toward PLATO programs that would be useful in studying the structure of concepts. The VERBOSE program records the keyset activities of two people. One person generates a string of words by free association at a keyboard. The other sees the last word in the string and adds a word. The first subject sees the last two words, his own and his colleague's, and types a link word. The link word is assumed to indicate in some way the relationship that the typist sees between the last two words.

Hickey and Newton (64-0103) designed twelve alternative versions of 59-frame program to teach the economic concept Gross National Product by systematically manipulating three sequence variables: order, position and directionality. They obtained significant differences in learning effectiveness with the three versions.

Sheridan and Mayer (65-0305, 63-1202) and Bio-Dynamics, Inc., (65-0403) describe a phylogenic strategy for sequencing the content of a program that teaches the function and structure of a system. Following the phylogenic sequence, the trainee behaves as an inventor, causing the subject system to proceed in its development through the various stages, or "phyla," in its evolution, either hypothetical or real.

Avner (64-0006) used the PLATO system in an unsuccessful search for heart rate correlates of insight. He defined insight or discovery as (1) a sudden change from problem answering to correct prediction as soon as the regularity of answers is perceived, (2) correct solution without new response behavior, etc.

3. Rules and Examples

Krumboltz and Yabroff (65-1104) measured the teaching efficiency of inductive and deductive sequences with varying degrees of alternation between problem-solving (example) and rule-stating. The subject-matter was elementary concepts in educational measurement. In the inductive/low alternation frequency form, all examples occurred before the rule-stating frames. The deductive/low alternation frequency form presented rules

and examples in the opposite order. They found inductive and deductive forms took the same amount of time and yielded the same amount of transfer, but students who studied by the inductive method (rules last) took less time to state rules in the criterion test.

4. Acquisition, Test and Review

Two of the principal elements in programmed instruction sequences are reinforced (R) trials or frames, and non-reinforced or test (T) trials. Izawa and Estes (65-0802) studied the optimal sequencing of R and T trials in teaching paired associates. The course of learning was affected by the ratio of R's to T's and by their arrangement in repetitive sequences. Overall the sequence RTRT. . . appears to be most nearly optimal. They conclude that a stimulus-fluctuation model gives a better account of acquisition and retention phenomena than a one-element model.

In a study of repetition and review in programmed instruction, Reynolds et al (64-1204) found that repetition above the usual level in a linear program is of no benefit but that spaced review is potentially beneficial.

Hershberger (65-205) compared three intervals of delay between the initial stimulus presentation and subsequent testing. In the first sequence, the student reread the stimulus item <u>before</u> the test frame; in the second, <u>after</u> the test frame; and in the third only the correct answer was exposed after the student responded. There was an effect on errors made during the program, but not on achievement. In any case, however, self-testing was superior to no self-testing.

D. ADAPTIVITY

A linear program is adaptive only in rate. The student progresses through the sequence of frames at his own pace. Intrinsic or adaptive programs are adaptive with respect not only to rate, but to content and/or instructional method as well. Content or method alternatives (or branches) are selected as a function of student performance. The decision structure on which the choice of instructional alternatives is made by the computer at each choice point in the program is therefore of considerable interest.

Each criterion frame in the program is a test item. Whether the student constructs his response or chooses between alternatives, the computer matches the response against a set of stored criteria for that item. The stored criteria for the multiple-choice format can be very simple, e.g. "If button A, then correct." In matching a constructed response against a set of alternatives, as in COURSEWRITER, a certain amount of response processing (see p. 20 and 66-0304) may be required before the response can be made to match a stored criterion for either a correct or incorrect response.

In PLATO III "evaluators" compare student performance with specified criteria and branch to additional expository material until these criteria are met (64-0702). Among the additional material are the eight "help" sequences.

In the BBN Socratic system the computer control language employs conditional expressions which take into consideration the history of the learner's actions in the program (Feurzeig, 65-0302).

In a computer-assisted study of speed reading, Strollo (64-0504) based the choice of instructional material on a statistical evaluation of the student's total behavior in comparison with other students' total behaviors, the statistics changing as new students took the course.

The SOCRATES system at the Training Research Laboratory, University of Illinois was intended to be adaptive in three ways: (1) to learn about the student as it teaches him, (2) to examine what has been learned by the student and make decisions about the rules (e.g. inductive or deductive) used to teach him, and (3) to make decisions about the criteria which are used for evaluating performance (Stolurow, 65-0701).

Shuford (65-0501), Shuford and Messengill (66-0307) and Baker (65-0301) have described sophisticated decision structure by which the computer not only matches the student's response to a multiple-choice frame with the correct response, but records the degree of certainty he indicates for all of the alternatives offered by the program at the choice point, both right and wrong. Unlike the conventional multiple-forced choice program, the student makes no "errors." He progresses through levels of certainty and computer always acts in the direction of raising his certainty.

E. FRAME CONSTRUCTION

Most PI and CAI programs are the product of trial-and-error and empirical generalization, a procedure some refer to as instructional engineering. Some variables under control of the programmer are step size, frame difficulty, prompting, confirmation, variety of examples, practice, response mode, timing of feedback, etc.

Seidel (66-0205) and Seidel and Rotberg (65-0606) compared prompting, confirmation, naming (of rules) and variety (of examples) in two experiments conducted during a ten-week programmed instruction course in computer programming. They found that prompting led to more efficient acquisition than confirmation, but when it came to writing programs during the test phase confirmation during acquisition led to better results. Their results also suggest that naming the rules, in addition to writing computer programs during training, aids performance when writing programs on the criterion tests. But writing rules during training actually hindered students in writing computer programs later on the criterion tests. A variety of examples was superior to no variety.

Goss (65-0207) reports an experiment, not with programmed instruction materials but with paired associates, which indicates that, as response integration and associative strength between stimulus and response items increase, the appearance of the response item (as a confirming response) becomes less necessary for the maintenance of correct overt responses by the subject.

Malpass and his colleagues (63-0701) found multiple-choice and keyboard response (modified completion) modes, did not yield significantly different results in teaching word-recognition and spelling to retardates.

Joanna Williams (66-0805) compared four response techniques in a linear program (1) standard constructed-response format, (2) standard multiple-choice format, (3) a combination format in which the constructed-response mode was used on frames that required technical terminology as responses and the multiple-choice mode on items where general vocabulary was required, and (4) a combination format in which response-mode was uncorrelated with item-type. Groups (1) and (3) were significantly better than Groups (2) and (4) on a constructed-response post-test and on gain scores. The findings suggest that the use of a varied format may not in itself facilitate performance, but that the important variable may be the correlation between training mode and type of item.

Moore and Smith (65-0709) investigated a programming technique for relating frame difficulty to the ability of the learner. In four experiments they used programmed materials in programmed text form. Experiment (1) tested the hypothesis that achievement is a function of the interaction of the ability of the learner and the amount of information contained in each frame. Experiment (2) tested the same hypothesis, but with more precise definition of frame difficulty. Experiment (3) tested the hypothesis that practice of an attribute after its acquisition contributes to the acquisition of the concept. Experiment (4) tested the hypothesis that acquisition of a concept is a function of the interaction of the number of attributes associated per frame, the amount of practice of the attributes prior to conceptualization, and the intellectual ability of the learner.

Sumby (65-1007) found that words presented visually will be learned more rapidly if they are clustered, but that the limits of improvement are extremely restricted. Further, clustering affects the strategy an individual adopts in responding.

Boersma (66-0604) attempted to determine the independent effects of delay of information feedback (IF), post-IF delay, and sex in a complex learning task in which 56 students learned a series of symbolic logic rules by programmed instruction. The data did not support his prediction that learning would be facilitated by increasing the post-IF interval, nor did it yield a significant delay-of-IF effect. But it did show that a simple explanation in terms of independent effects of delay-of-IF or post-IF interval is inadequate Boersma formulated a competing-response interpretation of delay involving error scores, answer latencies and the delay variables.

Rosen and Stolurow (64-0704) found no difference in the difficulty of two programs that presumably differed only in step size. They suspect, however, that their method of deleting frames produced only an illusion of change rather than actual change in step size. Moore and Smith (65-0709) also investigated frame difficulty.

Do affective verbal terms undermine the effect of formal, logical, or quantitative terms that appear in programmed instruction frames? Frase (65-0908) studied this question in the learning of syllogisms. He found that, in judging the validity of syllogisms in which the affective terms were highly inconsistent with the formal terms, the Ss at first made snap judgements that were incorrect, but later were more deliberate. A moderate level of incompatibility resulted in the greatest number of errors.

VII PROGRAM PREPARATION AND EVALUATION

A. PROGRAM PREPARATION

Program preparation is undoubtedly the principal bottleneck in CAI. Swets and Feurzeig (65-1001) report that 30 hours were required for a physician and computer programmer to prepare the medical case used to demonstrate the application of the Socratic System to instruction in medical diagnosis. An additional 30 hours of computer programming and clerical transposition were needed, plus several hours for editing the English prose. The student's vocabulary consists of 40 questions and 35 declarative statements.

Klaus (65-0909) believes one hour of instruction per week, or one week per year, is a reasonable production standard for the development of programmed instruction materials. He concludes that, unless programming itself is automated, it will often be necessary to resort to conventional methods of instruction. He describes a seven-step procedure he has followed for gradually automating instruction. He believes the procedure can save substantial amounts of programming effort.

There appear to be at least two ways to facilitate programming through the use of the computer itself. Roderburg, Cluck and Murray (64-1102) describe a procedure in which the computer structures the knowledge to be taught. The subject matter specialist first designates all the elements of information to be taught and the immediately preceding element. The computer then establishes higher order precedence relationships eliminating redundant paths among elements of information or concepts to be taught and through this knowledge structure. The precedence relationships are illustrated in a graph

In a second approach, the instructional language is designed to query the instructor at each step in program construction and thereby keep him aware of the instructional alternatives open to him at each point. Feingold and his colleagues (66-0703) have developed this feature in PLANIT, and Feurzeig has promised it for MENTOR.

In the developmental evaluation of programmed instruction materials, how many students should be used as a basis for accepting or rejecting frames? Francke et al (65-0204) related this question to the problem of the statistician in testing a large number of hypotheses. The hazards of small samples (N 15) were examined. Wide variations in efficiency among samples of a given size were observed in terms of (a) rejection of acceptable frames and (b) retention of unacceptable ones. It was recommended that samples be as large as practical.

B. EVALUATION

Many observers of the educational scene, including LOOK, LIFE, and the SATURDAY REVIEW have pointed with alarm at the high cost of CAI. We can therefore expect some earnest attempts to demonstrate increased learning effectiveness of CAI in comparison with other more conventional methods, including programmed instruction.

Hopefully the efforts at comparative evaluation will be more efficient than the similar evaluations of programmed instruction five to seven years ago. Hartley (66-0102) reviewed no less than 112 studies comparing programmed with conventional instruction. He found that only six of the 112 studies met four minimum criteria: The study should (1) take longer than five instruction hours, (2) use more than 15 students in each group, (3) report the time required to complete and (4) report pre- and post-test results. In the studies that met these criteria, programmed instruction was found more effective than conventional instruction.

Eckstrand (64-0903) sees increased emphasis placed on measuring the results of training. He distinguishes between criterion-referenced and norm-referenced proficiency measurement. Programmed instruction has been largely instrumental in the wider adoption of criterion-referenced measures. The same behavioral objectives established for programmed instruction subsequently are used as criteria for program evaluation. Eckstrand identifies three classes of problem in developing proficiency measures: Measurement problems, relevance or validity, and sampling.

The ultimate criterion for automated instruction is student achievement per unit time and cost, but there are many intermediate or related criteria, such as error rate, reaction time, data rate requirement placed on the system, student attitude, etc. Eight performance criteria are discussed in connection with the evaluation of PLATO II (62-0702).

Several investigators have already compared the learning effectiveness of CAI and more conventional instruction. In an early evaluation at the University of Illinois, nine students in an introductory course in digital computers took three lessons via PLATO II. Their examination grades paralleled those of the rest of the class and they were enthusiastic about CAI (62-0702).

Grubb and Selfridge (64-0302) described a typical experimental design used to compare CAI performance with instruction via programmed text or lecture. The three performance criteria were mean instruction time, mean review time, and average achievement score. The course was the first half of a one-semester course in psychological statistics. Students under CAI covered the material in 5.3 hours compared with 49 hours for the lecture mode and 12.2 hours for the programmed text The average achievement score in the CAI mode was 94.3 compared with 58.4 in the lecture mode.

Schurdak (65-0705) also compared CAI, PI, and conventional instruction. He had 48 students at Columbia learn a portion of a course in FORTRAN by one of the three methods. The CAI system was comparable to that used by Grubb and Selfridge. an IBM 1440-1448 with IBM 1050 terminals. All groups had equivalent scores on the Henmon-Nelson Tests of Mental Ability. Achievement tests were administered the day following course completion Students under CAI completed the course in 243.2 minutes compared with 245.4 minutes for programmed instruction and 269.1 minutes for the lecture mode Similarly, the average achievement score in the CAI mode was 87.4% compared with 76.2% for PI and 70.6% for the conventional lecture presentation. While the trend parallels the findings obtained by Grubb and Selfridge, the only statistically significant difference is between achievement under CAI and the other modes. Differences among groups on the achievement test were less marked for brighter students. Student attitudes toward CAI and PI were generally good.

Malpass, et al (63-0701) compared two automated teaching procedures for helping retarded children acquire certain word recognition, reading, and spelling skills with conventional classroom instruction. The two automated procedures were (1) a multiple-choice presentation and (2) a typewriter key-board (modified completion) presentation. Both automated procedures were more effective than conventional classroom instruction, and provided gains comparable to individual tutoring. Both types of automated instruction engendered extraordinarily high levels of retention over a 60-day period. Multiple-choice and keyboard methods were not significantly different from each other in terms of teaching word-recognition and spelling

Student reactions to CAI were reported by Wodtke and his associates (65-0902) who found that some students, especially low achievers, considered the CAI presentation on a remote terminal of the IBM Yorktown system too rapid. The authors suggest student-controlled pauses.

Grubb (65-0906) points to the economic advantage of assigning two students instead of one to each CAI terminal. He investigated the pairing of students in a CAI course in statistics. His results indicate that students paired on the basis of their College Entrance Examination Board verbal scores will do as well on the final examination as students who study individually at the CAI terminals.

REFERENCES

THE IBM RESEARCH CENTER TEACHING MACHINE PROJECT BINARY ARITHMETIC•IBM65590001
0• TYPEWRITER• STUDENT INTERFACE• DISPLAY TECHNIQUES• CENTRAL COMPUTERS*590001
RATH•G.J•• ANDERSON NANCY S•• AND BRAINERD•R•C•*3001/R234*IN GALANTER•E•590001
(ED•)• AUTOMATIC TEACHING• THE STATE OF THE ART• NEW YORK WILEY• 1950* 590001

THE TEACHING MACHINE AS A CONTROL MECHANISM+GAME•INSTRUCTIONAL LOGIC*PAS600601
K•G•*5140/P282*TRANSACTIONS OF THE SOCIETY OF INSTRUMENT TECHNOLOGY• JUN600601
E 1960• 72-89* 600601

GENERAL PURPOSE DIGITAL COMPUTERS FOR ENGINEERING AND SCIENTIFIC APPLICA610101
TIONS*MACGOWAN•R•A• AND WHIGHAM•W•L•*3500/M140*HUNTSVILLE•ALA-US ARMY BA610101
LLISTIC MISSLE AGENCY••REPORT RF-TR-1-61 (AD 249690)• 1961* 610101

BENDIX G-20 INSTALLATION+REMOTE STATIONS• CARNEGIE INST• TECH•*CARNEGIE 610701
INSTITUTE OF TECHOLOGY*3535/C280*DIGITAL COMPUTER NEWSLETTER•OFFICE OF N610701
AVAL RESEARCH• 1961• VOL•13• NO•3• 12-13* 610701

PLATO - AN AUTOMATIC TEACHING DEVICE+UNIV•OF ILL••CSL•STUDENT INTERFACE*611201
BITZER•D•*3345/B624*IRE TRANSACTIONS ON EDUCATION E-4•1961•157-161* 611201

PLATO II A MULTIPLE-STUDENT COMPUTER CONTROLLED TEACHING MACHINE+UNIV•OF620001
ILL••CSL•STUDENT INTERFACE•CENTRAL COMPUTER*LICHTENBERGER•W•*3345/L699*C620001
HAP• IN COULSON•J• (ED•)•PROGRAMMED LEARNING AND COMPUTER BASED INST•• N620001
•Y•• WILEY• 1962* 620001

APPLICATION OF A COMPUTER CONTROLLED AUTOMATIC TEACHING SYSTEM TO NETWOR620002
K SYNTHESIS+UNIV•OF ILL••CSL•PLATO•INSTRUCTIONAL LOGICS•TUTORIAL*BACHMAN620002
•R•*2160/B124*URBANA• ILL•• UNIV• OF ILL•• COORDINATED SCIENCE LABORATOR620002
Y REPORT I-115• 1962* 620002

CAPACITY OF THE PLATO II SYSTEM USING THE CSXL COMPUTER AS THE CONTROL E620003
LEMENT+UNIV•OF ILL••CSL•CSXL COMPUTER•PLATO*BOBOTEK•H•*3500/B663*URBANA•620003
ILL••UNIV•OF ILL••COORD•SCI•LAB•REP•I•118•1962* 620003

DESIGN OF A REMOTE DISPLAY CONSOLE+MIT/ESL• CATHODE TUBE• LIGHT PENS• TI620201
ME SHARING• STUDENT INTERFACE• REPONSE TECHNIQUES*RANDA•G•C•*3401/B186*C620201
AMBRIDGE•MASS• MASS• INST• OF TECH•• ELECTRONIC SYSTEMS LAB••REP•ESL-R-620201
132• 1962* 620201

PLATO 2 +UNIV• OF ILL•• TIME-SHARING• ILLIAC• VIDEO DISPLAY*COORDINATED 620401
SCIENCE LABORATORY• UNIV• OF ILL•*3345/C778A*DIGITAL COMPUTER NEWSLETTER620401
• OFFICE OF NAVAL RESEARCH• 1962• VOL• 14• NO•2• 18-24* 620401

HIGHSPEED DOCUMENT PERUSAL+IBM/YORKTOWN*INTERNATIONAL BUSINESS MACHINES 620501
CORP•*2320/I61*YORKTOWN•N•Y•-IBM RESEARCH CENTER REPORT AFOSR-2817(AD 28620501
5255)• 1962* 620501

LEARNING TO IDENTIFY NONVERBAL SOUNDSOAN APPLICATION OF A COMPUTER AS A 620601
TEACHING MACHINE+PDP-1B• BBN• PROGRAMMING*SWETS•J•A••MILLMAN•S•H••FLETCH620601
ER•W•E••AND GREEN•D•M•*2303/S975*J•ACOUS• SOC• AMER••1962•VOL•34• NO•7• 620601
928-935* 620601

PLATO I+STUDENT PERF•*COORDINATED SCIENCE LABORATORY• UNIV• OF ILL•*3345620702
/C778B*DIGITAL COMPUTER NEWSLETTER• OFFICE OF NAVAL RESEARCH• 1962 VOL•1620702
4 NO•3• 51-52* 620702

A TIME-SHARING SYSTEM FOR THE PDP1 COMPUTER+CRT DISPLAY•MIT*YATES•J•E•*3620703
210/Y31*CAMBRIDGE•MASS- MIT ELECTRONIC SYSTEMS LABORATORY REPORT NO• ESL620703
-R-140• 1962* 620703

PROBLEMS AND PROSPECTS OF TEACHING WITH A COMPUTER+TIME-SHARING• PLATO•U620802
NIV• OF ILL•• COMPUTER PROGRAMING*BRAUNFELD•P•G•*3340/B825*J•EDUC• PSYCH620802
OL•* 620802

COMPUTER SIMULATIONS OF A PERCEPTUAL LEARNING MODEL FOR SENSORY PATTERN 620803
RECOGNITION, CONCEPT FORMATION, AND SYMBOL TRANSFORMATION+NEURON NET MOD620803
EL*VOSSLER,C.*5200/U31*IN PROCEEDINGS OF IFIP CONGRESS 62, INTERNATIONAL620803
FEDERATION FOR INFORMATION PROCESSING, PP. 413-418. AMSTERDAM, NORTH-HO620803
LLAND PUBLISHING CO., 1962* 620803

THE USE OF AN AUTOMATIC COMPUTER SYSTEM IN TEACHING+UNIV.OF ILL., PLATO,620901
TIME-SHARING, STUDENT PERFORMANCE, COMPUTER PROGRAMMING*BRAUNFIELD, P.G.620901
AND FOSDICK, L.D.*3345/B825*URBANA,ILL.,UNIV. OF ILL., COORDINATED SCIEN620901
CE LAB. REP. R-160,1962* 620901

WANTED-A REACTIVE TYPEWRITER+LIBRARY, CATALOGS, LANGUAGES*MOOERS,C.N.*34621001
00/M817*CAMBRIDGE,MASS- ZATER CO., 1962* 621001

DESCRIPTION AND USE OF A COMPUTER-CONTROLLED TEACHING SYSTEM+UNIV.OF ILL621002
.CSL.PLATO*BITZER,D.*3345/B624*PRO. OF NAT.ELEC.CONF.,OCT.1962,787-792* 621002

AUTOMATIC LANGUAGE ANALYSIS+NATURAL LANGUAGE,FLEX,DATA RETRIEVAL*THORNE,621201
J.P.*4014/T496*BLOOMINGTON,IND.-INDIANA UNIV., REPORT RADC-TR-63-UU (AD 621201
297781 TAB), 1962* 621201

SELF-DIRECTED INQUIRY IN CLINICAL NURSING INSTRUCTION BY MEANS OF THE PL630004
ATO COMPUTER-CONTROLLED SIMULATED LABORATORY+UNIV.OF ILL.,CSL,INSTRUCTIO630004
NAL LOGICS,STUDENT VARIABLES,INDIVIDUAL DIFFERENCES*BITZER,MARYANN*2304/630004
B624*URBANA,ILL.,UNIV. OF ILL., COORD.SCI.LAB.REP. R-184, 1963* 630004

LEARNING MACHINES+CONDITIONAL PROBABILITY*PASK,GORDON*5000-P282*SYSTEM R630005
ESEARCH LTD., 20, HILL RISE, RICHMOND, SURREY, U.K.* 630005

AN EXPERIMENTAL EVALUATION OF THE ROLE OF REMEDIAL FEEDBACK IN AN INTRIN630102
SIC PROGRAM+REMEDIAL MATERIAL*KAUFMAN, R.A.*6210/K21*J. PROGRAMED INSTRU630102
CT., VOL.2, NO.4, WINTER 1963* 630102

SOME CONJECTURES ABOUT INSPECTION BEHAVIOR IN LEARNING FROM WRITTEN SENT630103
ENCES AND THE RESPONSE MODE PROBLEM IN PROGRAMED SELF-INSTRUCTION+BEL TE630103
L LAB, TEMPORAL CONTIGUITY, FRAME CONSTRUCTION, PROGRAMMING*ROTHKOPF,E.Z630103
*612./R845*J.PROGRAMED INSTRUCT.,1963,VOL.11, NO.4* 630103

SKETCHPAD-A MANMACHINE GRAPHICAL COMMUNICATION SYSTEM+MIT,DISPLAY,DRAWIN630104
G*SUTHERLAND,I.E.*34../S966*LEXINGTON,MASS-MIT LINCOLN LABORATORIES, REP630104
ORT AFESD-TDR-63-52 (AD 404549), 1963* 630104

PATTERN RECOGNITION COMPUTERS AS MODELS FOR FORM PERCEPTION+COMPUTER SIM630105
ULATIONS,PATTERN RECOGNITION*UHR,L.*5200/U31*PSYCHOLOGICAL BULLETIN, 196630105
3, VOL. 4.-73* 630105

THE APPLICATION OF PROGRAMMED INSTRUCTION AND AUTOINSTRUCTIONAL DEVICES 630201
IN COLLEGES AND THEIR RELATION TO A THEORY OF INSTRUCTION+THEORETICAL MO630201
DEL,CLASS,SDC*EVANS,D.C.*3100/R988*SANTA MONICA, CALIF.-SYSTEM DEVELOPME630201
NT CORP., REPORT SP 1084/000/01((AD 298711), 1963* 630201

INVESTIGATION INTO THE SPECIAL PROGRAMMING NEEDS FOR AN AUTOMATED LABORA630501
TORY FOR PSYCHOLOGICAL RESEARCH+REAL TIME,DATA ANALYSIS, STATISTICAL,EXP630501
ERIMENTATION,LANGUAGES,ESD*FREDKIN,E.*3000/F852*MAYNARD,MASS.-INFORMATIO630501
N INTERNATIONAL INC., REPORT ESD-TR-63-353, 1963* 630501

A NEW CONCEPT IN ARTIFICIAL INTELLIGENCE+CHILD, RADC,ADAPTIVE*CHOISSOR,J630502
.F. AND ...MON,J.W.*5140/C546*GRIFFISS AFB,N.Y.-ROME AIR DEV. CENTER, RE630502
PORT RADC-TDR-63228 (AD 409111), 1963* 630502

NELIAC-N- A TUTORIAL REPORT+PROGRAMMING,LANGUAGE,NPL*KALLANDER,J.W. AND630601
THAT...,.W.*4..0/.14*WASHINGTON,D.C.-US NAVAL RESEARCH LABORATORY, NRL630601
... ..., 1963* 630601

A COMPARISON OF TWO AUTOMATED TEACHING PROCEDURES FOR RETARDED CHILDREN(630701
SUMMARY)+READING, SPELLING, MULTIPLE-CHOICE, TYPEWRITER KEYBOARD, STUDEN630701
T INTERFACE, INSTRUCTIONAL ALTERNATIVES, PROGRAMMING*MALPASS.L.F.. GILM0630701
RE.A.S.. HARDY.M.W.. AND WILLIAMS.C.F. *6210/M259*TAMPA, FLORDIA UNIV. 0630701
F SOUTH FLORIDA,1963* 630701

INFORMATION SYSTEMS SUMMARIES+ONR, COMMUNICATION,STORAGE*OFFICE OF NAVAL630702
RESEARCH,DEPT. OF THE NAVY*1020/032*WASHINGTON.D.C.-OFFICE OF NAVAL RE630702
SEARCH, DEPT. OF THE NAVY, ONR REPORT ACR-81, 1963* 630702

NORMATIVE FEEDBACK IN AUTOMATED INSTRUCTION+SUBJECTIVE FEEDBACK, SKILLS,630901
METAL SURFACES*MAGER.R.F. AND CLARK, D. CECIL*6210/M191*PSYCHOL. REP.. 1630901
963, 13, 599-616* 630901

ADVANCED LANGUAGE PROCESSING PROCEDURES+ESD, QUERY LANGUAGE, NATURAL LAN630902
GUAGE*KEYSER, S. J.*4014/K44*BEDFORD, MASS.0U.S. AIR FORCE, ELECTRONIC S630902
YSTEMS DIV., REPORT NO.ESD-TDR-63-620, 1963* 630902

AN INFORMATION SYSTEMS APPROACH TO EDUCATION+SDC, CLASS*RUANS, D.G.*3325630903
/R988*SANTA MONICA, CALIF.0 SYSTEM DEVELOPMENT CORPORATION, TECHNICAL ME630903
MORANDUM TN-1495, 1963* 630903

THE SOCRATIC SYSTEMO A COMPUTER SYSTEM FOR AUTOMATED INSTRUCTION+BBN*FEU631001
RZEIG, W.. HARRIS, JUDITH R.. AND SWETS..J.A*3335/F426B*CAMBRIDGE, MASS.631001
0 BOLT BERANEK AND NEWMAN INC.. REPORT NO. 1065,1965* 631001

RESEARCH ON CYBERNETIC INVESTIGATION OF LEARNING AND PERCEPTION+ SAFE, S631002
IMULATION*PASK.G.*5140/P277*RICHMOND, SURREY, U.K.-SYSTEM RESEARCH LTD.,631002
1963* 631002

AUTOMATIC MESSAGE RETRIEVAL-STUDIES FOR THE DESIGN OF AN ENGLISH COMMAND631101
AND CONTROL LANGUAGE SYSTEM+SEARCHING,NATURAL LANGUAGE,INFORMATION,ESD*A631101
RTHUR D. LITTLE INC.*4014/L778*CAMBRIDGE MASS- ARTHUR D. LITTLE REPORT 631101
ESD-TR-63-673, 1963* 631101

COMPARATIVE STUDIES OF PRINCIPLES FOR PROGRAMMING MATHEMATICS IN AUTOMAT631201
ED INSTRUCTION+UNIV. OF ILL.. TRL, MENTAL ABILITIES*STOLUROW.L.M. AND BE631201
BERMAN, M.*6000/S876A*URBANA, ILL.0 UNIV. OF ILL.. 1963, SEMIANNUAL REP0631201
RT, JUNE6-DEC6, 1963, U.S. OFFICE OF EDUCATION PROJ. NO.711151.01* 631201

DESIGN AND USE OF INFORMATION SYSTEMS FOR AUTOMATED ON-THE-JOB TRAINING0631202
I. CONCEPTUAL AND EXPERIMENTAL APPROACHES+ESD, PROGRAMMING, SYMBOLOGY, 631202
TASK LOGIC, FLOW DIAGRAM, SAGE, NATURAL LANGUAGE, SEQUENCE VARIABLES*SHE631202
RIDAN.T.B. AND MAYER, SYLVIA R.*3000/S552*BEDFORD, MASS.0 AIR FORCE SYSTE631202
MS COMMAND, DECISION SCIENCES LABORATORY, L.C. HANSCOM FIELD, TECHNICAL 631202
DOCUMENTARY REPORT NO. ESD-TDR-64-234, 1963* 631202

IBM1401 OR IBM1440 OPERATING SYSTEMO COMPUTER ASSITED INSTRUCTION+COURSE640001
WRITER, TIME-SHARING*INTERNATIONAL BUSINESS MACHINES CORPORATION*3510/I6640001
1*IBM SYSTEM REFERENCE LIBRARY, FILE NO.1401/144 48, FORMC24-3253-0* 640001

GUIDEBOOK TO SIMULATED STATISTICAL INFERENCE PROGRAM SIMIN+MICH. STATE 640002
UNIV.*FRYE, C.G.*2106/F948*EAST LANSING, MICH. CHARLES H. FRYE, MICH. S640002
TATE UNIV.. UNPUBLISHED STUDENT GUIDE* 640002

THE PDP-1 COMPUTER AS A TEACHING AID IN PROBLEM-SOLVING+ BBN, SOCRATIC S640004
YSTEM, CONVERSATION, MEDICAL DIAGNOSIS, VOCABULARY, ALPHABET GUESSING G640004
AMES*FEURZEIG, W.*3520/T426*PROCEEDINGS OF THE DIGITAL EQUIPMENT COMPUTE640004
R USERS SOCIETY 1963, 203-213* 640004

HEART RATE CORRELATES OF INSIGHT+UNIV. OF ILL..CSL,STUDENT VARIABLES,IND640006
IVIDUAL DIFFERENCES,PLATO*AVNER.R.*3610/A959*URBANA,ILL.. UNIV. OF ILL..640006
COORD.SCI.LAB.REP.R198,1964* 640006

DETECTION OF RATE CHANGES IN PERIODIC PHENOMENA+UNIV.OF ILL..CSL,INDIVID640007

UAL DIFFERENCES.METHODOLOGY*AVNER.R.*3600/A959*URBANA.ILL..UNIV.OF ILL..640007
COORD.SCI.LAB.REP.,R235,1964* 640007

A PROPOSAL FOR A NATIONAL CONFERENCE ON THE APPLICATION OF SCIENTIFIC DE640101
VELOPMENTS TO INSTRUCTIONAL TECHNOLOGY+UNIV. OF PITTS., ONR*GLAZER, R.* 640101
1200/G553*PITTS., PENNA UNIV. OF PITTS, TRAINING RESEARCH AND DEVELOPME640101
NT CENTER, 1964* 640101

THE LOGICAL BASIS OF TEACHING 1. THE EFFECT OF SUBCONCEPT SEQUENCE ON L640103
EARNING+ENTELEK, KNOWLEDGE SPACE, CONCEPT*HICKEY, A.E. AND NEWTON, J.M.*640103
6100/H628*NEWBURYPORT, MASS. ENTELEK INC., 1964* 640103

A PLATO PROGRAM FOR INSTRUCTION AND DATA COLLECTION IN MATHEMATICAL PROB640104
LEM SOLVING+LINEAR PROGRAM.LECTURE DISCUSSION.INSTRUCTIONAL ALTERNATIVES640104
.AMRL*EASLEY.J..GELDE*2103/E13*URBANA, ILL., UNIVERSITY OF ILL., COORDIN640104
ATED SCIENCE LABORATORY, REPORT NO. R-185,1964* 640104

DESIGN AND USE OF INFORMATION SYSTEMS FOR AUTOMATED ON THE JOB TRAINING.640105
DESIGN OF SELFINSTRUCTIONAL FEATURES+ESD*SHERIDAN.T.B. AND DUGGAR.B.C.*3640105
100/S552*CAMBRIDGE.MASS-BIO-DYNAMICS, INC., REPORT ESD-TDR-64-234, 1964*640105

A STATISTICAL OPTIMIZATION OF SEARCH TIME IN AN INFORMATION RETRIEVAL SY640106
STEM+PENNA. UNIV..MAGNACARD*LEIFER.P.L.*3000/L525*PHILADELPHIA.PA.-PENNA640106
. UNIV.. MOORE SCHOOL OF ELECTRICAL ENGINEERING, REPORT R-64-17,1964* 640106

TEACHING MACHINES AND PROGRAMMED LEARINGIN THE SOVIET BLOC (A SURVEY OF 640201
THE PUBLISHED LITERATURE, 1962-1963)+RADON, UMSHN COMPUTER, TIME-SHARING640201
. SOVIET UNION, LITERATURE REVIEW*SCHULTZ.A.A.*1 10/S387*U.S. DEPARTMENT640201
OF COMMERCE, OFFICE OF TECHNICAL SERVICES, JOINT PUBLICATIONS RESEARCH S640201
ERVICE, REPORT 1164-21587, AUGUST,1964* 640201

SYSTEM DESIGN FOR A CONTINUOUS PROGRESS SCHOOL, PART 1*EGBERT, R.L., COG640202
SWELL, J.F.*3100/E28*SANTA MONICA.CALIF. SYSTEM DEVEL. CORP.,REPORT NO.T640202
M-1493/103/00,1964* 640202

THE COMPUTER AS AN INSTRUCTIONAL TOOL, A SUMMARY SDC, LEARNING NEEDS, T640203
EACHING STRATEGIES*BUSHNELL, D.D.*1000/B979*SANTA MONICA CALIF. SYSTEM 640203
DEV.CORP. REPORT NO.SP-1554, 1964* 640203

OPTIMAL STRATEGIES AND HUMAN BEHAVIOR IN FUNGUS-EATER GAME 4+SEQUENTIAL 640204
DECISIONS*NAKAHARA.J. AND TODA,M.*5130/N163*BEDFORD.MASS- AIR FORCE SYST640204
EMS COMMAND, ELECTRONIC SYSTEMS DIV., REPORT ESD TDR-64-237, 1964* 640204

COMPUTER-AIDED TEACHING+MIT, CIVIL ENGINEERING, IBM1620, IBM7094, STRUCT640301
URES, SIMULATION, LANGUAGES, CENTRAL COMPUTERS, COGO, STRESS, SEPOL*MASS640301
ACHUSETTS INSTITUTE OF TECHNOLOGY*2241/M414*COMPUTERS AND AUTOMATION, MA640301
Y.1964, VOL.13, NO.3* 640301

COMPUTER TUTORING IN STATISTICS+COURSEWRITER, IBM LABS., IBM650 RAMAC, D640302
ESCAL, STEP SIZE*GRUBB, R.E. AND SEFRIDGE, LENORE D.*2105/G885* COMPUTER640302
S AND AUTOMATION, MARCH 1963, VOL. 13, NO.3* 640302

NEW SOLUTIONS TO IMPLEMENTING INSTRUCTIONAL MEDIA THROUGH ANALYSIS AND S640303
IMULATION OF SCHOOL ORGANIZATION+SDC, SYSTEM ANALYSIS COMPUTER-SIMULATIO640303
N, DYNAMIC MODELS*COGWELL, J.F., EGBERT, R.L., ET AL*3100/C677*SANTA MON640303
ICA.CALIF. SYSTEM DEV. CORP., TECH.MEMO.NO. TM-1809, 1964* 640303

THE ROLE OF COMPUTERS IN EDUCATION+CLASSIFICATION, SCHEDULING, ADMINISTR640304
ATION*MACDONALD, N.*3000/M135*COMPUTERS AND AUTOMATION, VOL.13, NO.3, 13640304
-14* 640304

COMPUTERS IN EDUCATION- A REFERENCE GUIDE TO PROJECTS AND PAPERS+APPLICA640305
TIONS, BIBLIOGRAPHY, INSTRUCTIONAL LOGICS*PACKER.R.E.*1020/P119*COMPUTER640305
S AND AUTOMATION, 1964, VOL.13, NO.3, 27-28* 640305

IODERN LEARNING THEORY AND THE ELEMENTORY-SCHOOL CURRICULUM+STANFORD. M640306
ITHEMATICS, READING, INDIVIDUAL DIFFERENCE, LEARNING RATE, REINFORCEMENT,640306
OVERT CORRECTION, PROGRAMMING, REPONSE LATENCY, STUDENT INTERFACE*SUPPE640306
S.P.*5000/S959*AMER. ED. RES. J.,1962, VOL.1, NO.2, 79-93* 640306

COMPUTER BASED INSTRUCTION-INTRODUCTION TO THE IBM RESEARCH PROJECT+HARD640307
WARE,SOFTWARE,HUMAN LEARNING,COURSEWRITER,YORKTOWN*MAHER.A.*3301/M214*Y0640307
RKTOWN HEIGHTS,N.Y.-IBM WATSON RESEARCH CENTER, RESEARCH REPORT RC-1114,640307
1964* 640307

AN EXECUTIVE PROGRAM FOR MULTIPLE CONSOLES+NAVAL SUPPLY OFFICE,IBM1410*P640308
RYWES,N.W. AND MILLER,D.H.*3210/P973*PHILADELPHIA,PA.- PENNA. UNIV., MO0640308
RE SCHOOL OF ELECTRICAL ENGINEERING, REPORT R-64 13, 1964* 640308

PLATO 2 AND 3+UNIV. OF ILL., INQUIRY TRAINING, MATHEMATICS, CDC 1604, PH640401
YSICS, REPLAB*COORDINATED SCIENCE LABORATORY, UNIV. OF ILL.*3345/C778C* 640401
DIGITAL COMPUTER NEWSLETTER, OFFICE OF NAVAL RESEARCH, 1964, VOL.16, NO.640401
2,24-26* 640401

PROBLEMS, PROCEDURES, PITFALLS, AND PROMISE OF PROGRAMING PRACTICES+ADMI640402
NISTRATION, SOCRATES*STOLUROW.L.M.*8000/S876*BULLETIN OF THE NATIONAL AS640402
SOCIATION OF SECONDARY SCHOOL PRINCIPALS, 1964, VOL.48, 256-270* 640402

PRESENT STATUS AND FUTURE PROSPECTS OF COMPUTER-BASED INTRUCTION+SDC,CLA640403
SS*COULSON,J.E.*3325/C855*SANTA MONICA,CALIF.-SYSTEM DEVELOPMENT CORP.,R640403
EPORT SP-1629,1964* 640403

COMPUTER-BASED INSTRUCTIONO TODAY AND TOMORROW+TELEREGISTER,UNITED AIR L640404
INES, INSTAMATIC, MULTIPLE-CHOICE*GOODMAN, L.S.*3400/G653*DATA PROCESSIN640404
G FOR EDUCATION, 1964, VOL.3, NO.4, 2-5* 640404

SOME PROBLEMS IN INFORMATION SCIENCE WITH EMPHASIS ON ADAPTATION TO USE 640405
THROUGH MAN-MACHINE INTERACTION+SIMULATION, IBM/YORKTOWN*KOCHEN.M.*1000/640405
K76*YORKTOWN HEIGHTS,N.Y.-INTERNATIONAL BUSINESS MACHINES CORP. REPORT 640405
AFCRL 64-87, VOLS. 1 AND 2, 1964* 640405

PLATO A COMPUTER-CONTROLLED TEACHING SYSTEM+UNIV.OF ILL.,CSL,CENTRAL COM640406
PUTER,INSTRUCTIONAL LOGICS*BITZER.D.*3345/B624*ANN.CONV.DEPT.AUDIOVISUAL640406
INSTRUCTION,ROCHESTER,N.Y.,22 APRIL 1964,ALSO,SASS AND WILKINSON(EDS.), 640406
COMPUTER AUGMENTATION OF HUMAN REASONING,WASH. SPARTAN, 1965* 640406

THE COMPUTER THAT TALKS LIKE A TEACHER+SOCRATIC SYSTEM, BBN, ACCOUNTING*640503
FEURZEIG.W.*3335/F426A*JOURNAL OF ACCOUNTING, MAY 1964* 640503

AGENERALIZED TEACHING MACHINE DECISION STRUCTURE WITH APPLICATION TO SPE640504
ED READING+MIT/OR, STATISTICAL EVALUATION, DECISION LOGIC*STROLLO, T.R.*640504
2281/S919*TECHINICAL DOCUMENTARY REPORT NO.ESD-TDR-64-523, MAY1964, DECI640504
SION SCIENCE LABORATORY, ELECTRONIC SYSTEMS DIVISON, AIR FORCE SYSTEMS C640504
OMMAND, UNITED STATES AIR FORCE, L.G. HANSCOM FIELD, BEDFORD, MASS.* 640504

COMPUTER SIMULATION OF HUMAN BEHAVIOUR+RAND CORP.,HUMAN LEARNING, COMPUT640505
ER SIMULATION*FEIGENBAUM, E.A*5200/F297*SANTA MONICA,CALIF.O RAND CORP.,640505
MAY,1964* 640505

A STUDY OF DIGITAL COMPUTERS FOR A REAL TIME TRAINING SIMULATION RESEARC640506
H SYSTEM+IIT, PACKARDBELL440, SDS9300*ANDERSON,K.W. AND EWING,D.*5300/A5640506
45*CHICAGO,ILL- ILL INST OF TECH, REPORT AMRL-TDR-64-22, 1964* 640506

A CONVERSATIONAL TEACHING MACHINE+BBN, SOCRATIC SYSTEM, PDP-1, MEDICAL D640601
IAGNOSIS, TIME-SHARING*FEURZEIG.W.*3335/F426F*DATAMATION, 1964, VOL. 10,640601
NO. 6* 640601

RESEARCH RELATING TO THE TRL SYSTEM FOR ORGANIZING CONTENT TO REVIEW AND640602
TEACH EDUCATIONAL SUBJECTS(SOCRATES)+PROGRAM GENERATION, IBM1620, STUDEN640602

T INTERFACE, SOUND, DISPLAY TECHNIQUES, RESPONSE TECHNIQUES, LEARNING SE640602
T, INSTRUCTIONAL LOGICS*STOLUROW,L.M.*3340/S876*URBANA, ILL.- UNIV. OF I640602
LL., TRAINING RESEARCH LABORATORY, PROPOSAL TO ONR FOR CONTINUATION OF C640602
ONTRACT 1964 NONR 3985(04)* 640602

COMPUTERS, THEIR IMPACT ON INSTRUCTION, ON EDUCATIONAL PLANNING, AND ON 640603
THE CURRICULM*CARTER,L.F*3000/C324*SANTA MONICA,CALIF. SYSTEM DEVELOPME640603
NT CORP. REPORT SP-1628,1964* 640603

SIR, A COMPUTER FOR SEMANTIC INFORMATION RETRIEVAL+MIT/MAC,SIR, LISP, NA640604
TURAL LANGUAGE*RAPHAEL,B.*4014/R217*CAMBRIDGE, MASS.O MASS. INST. OF TEC640604
H., MAC-TR-2 THESIS, 1964* 640604

TECHNICAL AIDS TO CREATIVE THOUGHT (PROJECT TACT)+HARVARD,ANIMATED BLACK640605
BOARD, CALCULUS, GENETICS, STATISTICS, DISPLAY TECHNIQUES*OETTINGER,A.G.640605
*3401/028*CAMBRIDGE,MASS.O THE COMPUTATION LABORATORY OF HARVARD UNIVERS640605
ITY, JUNE 1964* 640605

MULTIPLE PROCESSING TECHNIQUES+SOLOMON 2*WESTINGHOUSE DEFENSE AND SPACE 640606
CENTER*3200/W516*BALTIMORE,MD-WESTINGHOUSE CORP., DEFENSE AND SPACE CENT640606
ER, REPORT RADC-TDR-64-186, 1964* 640606

PILOT STUDIES OF PRINCIPLES OF PROGRAMMING+UNIV.OF ILL,TRL, COVERT RESPO640701
NSES, TEACHERS' PRESENCE, SEQUENCE VARIABLES, INTRUCTIONAL ALTERNATIVES,640701
FRAME CONSTRUCTION*STOLUROW,L.M., ROSEN, ELLEN F., FRINCKE, G.L., BATCH640701
ELOR,D., AND HIMEL,C.*6000/S876B*URBANA, ILL.O UNIV. OF ILL., 1964, TECH640701
. REP. NO.9, U.S. OFFICE OF EDUCATION PROJECT NO.711151.01* 640701

PLATO I AND 2+UNIV. OF ILL. INQUIRY TRAINING, MATHEMATICS, FORTRAN, PHYS640702
ICS, ADAPTIVE, CATO, REPLAB*COORDINATED SCIENCE LABORATORY, UNIV. OF ILL640702
.*DIGITAL COMPUTER NEWSLETTER, OFFICE OF NAVAL RESEARCH, 1964, VOL.16, N640702
O.3, 14-17* 640702

SEQUENTIAL DECISION-MAKING IN A COMPUTER-CONTROLLED TASK+BAYESIAN DECISI640703
ON THEORY, LEARNING MODEL, SIMULATION*RAPOPORT,A.*5000/R219*JOURNAL OF M640703
ATHEMATICAL PSYCHOLOGY, 1964, VOL.1,NO.2, 351-374* 640703

AN ATTEMPT TO FIND AN A PRIORI MEASURE OF STEP SIZE+UNIV. OF ILL./TRL, M640704
ATHEMATICS, FRAME CONSTRUCTION, PROGRAMMING*ROSEN, ELLEN F. AND STOLUROW640704
, L.M.*6300/R813*URBANA, ILL.O UNIV. OF ILL., TRAINING RESEARCH LAB., TE640704
CHNICAL REPORT NO.13, 1964* 640704

THE SOCRATIC SYSTEM, A COMPUTER SYSTEM TO AID IN TEACHING COMPLEX CONCEP640803
TS+BBN, COMPILER, TIME-SHARING*FEURZEIG, W.*3335/F426E*CAMBRIDGE, MASS.-640803
BOLT BERANEK AND NEWMAN INC., STATUS REPORT NO.3, CONTRACT NONR 4340(00640803
0), 1964* 640803

CONTINUED REARCH ON THE SOCRATIC SYSTEM, A COMPUTER SYSTEM TO AID IN TEA640804
CHING COMPLEX CONCEPTS+COMPILER, TIME-SHARING,VOCABULARY*FEURZEIG, W.*33640804
35/F426D*CAMBRIDGE, MASS.- BOLT BERANEK AND NEWMAN INC., A PROPOSAL TO O640804
NR,CONTINUATION OF CONTRACT NONR 4340(00),1964* 0640804

COMPUTER-AIDED TEACHING IN MEDICAL DIAGNOSIS+SOCRATIC SYSTEM,TYPEWRITER 640805
CONSOLE, VOCABULARY, CONTINGENCIES,PDP-1*FEURZEIG, W., MUNTER, P., SWETS640805
, J., AND BREEN, M.*2161/F426*J. MED. EDUC.,1964, VOL.39, 746-754* 640805.

OPTIMUM TEACHING PROCEDURES DERIVED FROM MATHEMATICAL LEARNING MODELS+PA640806
IRED ASSOCIATES, DYNAMIC PROGRAMMING, MARKOV LEARNING MODELS, STANFORD 640806.
UNIV.*MATHESON,J.E.*5200/M427*STANFORD, CALIF.- STANFORD UNIV., COMPUT640806
ER-COORDINATED SYSTEMS, INSTITUTE IN ENGINEERING ECONOMICS SYSTEMS, REPO640806
RT CCS-2,1964* 640806

A MODEL AND CYBERNETIC SYSTEM FOR RESEARCH ON THE TEACHING-LEARNING PROC640901
ESS+SOCRATES,IDIOMORPHIC PROGRAMMING, SYSTEM ANALYSIS, INSTRUCTIONAL LOG640901
ICS*STOLUROW,L.M.*3440/S876A*URBANA, ILL.O UNIV. OF ILL., TRAINING RESEA640901

CH LAPORATORY, NONR TEC . REP. NO.4,1964. (PRESENTED AT SYMPOSIUM ON PS640901
CHOLOGICAL PROBLEMS IN CYBERNETIC RESEARCH, HUMBOLDT UNIV.. EAST BERLIN640901
GERMANY, SEPT.1964. PUBLISHED, IN GERMAN, IN PROCEEDINGS OF THE SYMPOS640901
UM* 640901

UMAN ENGINEERING IN THE DESIGN OF INSTRUCTIONAL SYSTEMS+ESD, SYSTEMS AN640902
LYSIS*MAYER, SYLVIA R.*3100/M468*BEDFORD, MASS. U.S. AIR FORCE, ELECTR640902
NIC SYSTEMS DIV.. TECHNICAL DOCUMENTARY REPORT NO. ESD-TDR-64-454,1964*640902

URRENT STATUS OF THE TECHNOLOGY OF TRAINING+WADC,TRAINING ENVIRONMENT, 640903
VALUATION, CRITERION-REFERENCED, MEASUREMENT, RELEVANCE, NORM-REFERENCE640903
, SAMPLING*ECKSTAND, G.A.*1000/E19*WRIGHT PATTERSON AFB, OHIO-AEROSPACE640903
MEDICAL RESEARCH LABORATORIES,REPORT NO.AMRL-TR 64-86,1964* 640903

HE COMPUTER AS AN EDUCATOR+SOCRATIC SYSTEM, COMPUTER-CONTROLLED SYSTEMS640904
STUDENT CONTROLLED SYSTEMS, COLLABORATIVE CONTROL SYS.. TEACHER CONTROL640904
ED SYSTEMS, EDISON RESPONSIVE ENVIRONMENT*FEURZEIG, W.*3335/F426*CONFER640904
NCE PROCEEDINGS, 8TH INTERNATIONAL CONVENTION ON MILITARY ELECTRONICS,W640904
SHINGTON, D.C.. 1964, 354-356* 640904

OLUTIONS FOR OPTIMAL DESIGNS OF STOCHASTIC LEARNING EXPERIMENTS+SDC,MA640906
HEMAT.MODELS, STIMLUS SAMPLING MODEL, OPTIMAL DESIGNS, DYNAMIC PROGRAMM640906
NG*DEAR, R.E.*5000/D285*SANTA MONICA, CALIF.- SYSTEM DEVELOPMENT CORP..640906
EPORT NO.SP-1765/000/00,1964* 640906

LATO 2 AND 3+REPLAB, PROOF, CATO, CDC1604*COORDINATED SCIENCE LABORATOR641001
, UNIV. OF ILL.*3345/C778E*DIGITAL COMPUTER NEWSLETTER, OFFICE OF NAVAL641001
ESEARCH, 1964, VOL. 16, NO. 4, 41-43* 641001

N EVALUATION OF MULTIPLE TRACKS IN A LINEAR PROGRAM+UNIV. OF PITTS. LAR641002
E-STEP BRANCHING, SMALL-STEP*GLASER, ROBERT, REYNOLDS, JAMES H.. HARAKA641002
, THEODORE, HOLZNAW, A.G. AND AHMA, JOHN S.*621 /G648*WRIGHT-PATTERSON 641002
IR FORCE BASE, OHIOO AEROSPACE MEDICAL RESEARCH LAB. REPORT NO. AMRL-TR641002
64-108, 1964* 641002

ETTER REPORT, PROGRESS OF WORK ON ONR CONTRACT NONR 3985(04)+UNIV. OF I641101
L.. SOCRATES, MASTER TUTORS, RETRIEVAL, CRT DISPLAY, STUDENT INTERFACE*641101
,TOLUROW,L.M.*3340/S876*URBANA, ILL.. TRANING RESEARCH LABORATORY, NOVEM641101
ER 1964* 641101

RELIMINARY RESEARCH ON THE TAXONOMY OF SUBJECT MATTER+MIT/OR, GEOMETRY, 641102
IATRIX ALGEBRA, PROGRAMMING, REMEDIATION,PROGRAM GENERATION*RODERBURG,T.641102
.. GLUCK, H.D.. AND MURRAY,G.R.*6000/R638*CAMBRIDGE,MASS.- MASS. INST. 641102
F TECH.. OPERT. RES. CENTER, REPORT IN-3-ESD-TDR 64-618, 1964* 641102

PROGRAM FOR THE SOLUTION OF A CLASS OF GEOMETRIC-ANALOGY INTELLIGENCE641103
-TEST QUESTIONS+LISP, AFCRI*EVANS, T.G.*5200/E92*AIR FORCE CAMBRIDGE RES641103
LABS. HANSCOM FIELD, MASS.. U.S.A. NOU,1964, AFCRL-64-884 PHYS.+ MATH.641103
SCI. RES. PAPER 1964* 641103

LEARNING SET FORMATION IN PROGRAMED INSTRUCTION+ERROR RATE*REYNOLDS,J.H.641104
GLASER,R.. AND ABMA,J.S.*5110/R462*WRIGHT-PATTERSON AFB, OHIO- BEHAVIO641104
RAL SCIENCES LABORATORY, AEROSPACE MEDICAL LABORATORIES, REPORT NO.AMRL-641104
TR-64-114, 1964* 641104

OPTIMAL STIMULUS PRESENTATION STRATEGY FOR A STIMULUS SAMPLING MODEL OF 641105
LEARNING+SDC*KARUSH, W. AND DEAR, R.E.*5000/K18*SANTA MONICA, CALIF.O SY641105
STEM DEVELOPMENT CORP.. REPORT NO.SP-1869, 1964* 641105

COMPUTER BASED SYSTEMS-THE NEW RESEARCH AID+UI/TRL, SOCRATES*DAVIS,D.J..641106
AND STOLUROW,L.M.*3000/D249*URBANA,ILL-UNIV OF ILL TRAINING RESEARCH LAB641106
ORATORY, TECHNICAL REPORT NO. 6, 1964* 641106

RESEARCH IN MAN-MACHINE COOPERATIVE SYSTEMS+STANFORD UNIV,RESPONSE PROBA641201
BILITY,DECISION LOGIC*SMALLWOOD,R.D.*3100/S635*STANFORD,CALIF.OSTANFORD 641201

UNIV. INSTITUTE IN ENGINEERING-ECONOMIC SYSTEMS. PROPOSAL NO. EES-64. 19641201
64* 641201

A PROPOSAL TO EXTEND CONTACT DA 28043 AMC 00073 IN SUPPORT OF THE RESEAR641202
CH PROGRAM OF THE UNIVERSITY OF ILL. COORDINATED SCIENCE LABORATORY 7.P641202
ROGRAMMED LOGIC FOR AUTOMATIC TEACHING OPERATIONS+ILLAC. TIME SHARING. C641202
DC-1604.UNIV. OF ILL.*COORDINATED SCIENCE LABORATORY. UNIV. OF ILL.*3345641202
/C778*URBANA, ILL.OUNIV. OF ILL. COORDINATED SCIENCE LABORATORY.1964* 641202

DEVELOPMENT AND EVALUATION OF A SELF-INSTRUCTIONAL COURSE IN THE OPERATI641203
ONAL TRAINING CAPABILITY QUERY LANGUAGE FOR SYSTEM473L.USAF HEADQUARTERS641203
+IBM1401.IBM1410.BRANCHING*CLAPP.D.J..YENS.D.P..SHETTEL.H.H.. AND MAYER.641203
S.R.*3326/C539*BEDFORD.MASS.OAIR FORCE ELECTRONIC SYSTEMS DIV..DECISION 641203
SCIENCE LABORATORY. REPORT NO. ESD-TR-64-662. 1964* 641203

REPETITION AND SPACED REVIEW IN PROGRAMED INSTRUCTION+REPETITION. SPACED641204
REVIEW. PROGRAMMING. INSTRUCTIONAL ALTERNATIVES*RENOLDS.J.H.. GLASER.R.641204
. ABMA.J.S.. AND MORGAN.R.L.*6210/B462A*WRIGHT-PATTERSON AIR FORCE BASE.641204
OHIO. AEROSPACE MEDICAL RESEARCH LAB. REPORT AMRL-TR-64-128.1964* 641204

THE SOCRATIC SYSTEM. A COMPUTER SYSTEM TO AID IN TEACHING COMPLEX CONCEP641205
TS.+PUNCTUATION. SOUNDEX. TELETYPE. COMPILER. TIME-SHARING. VOCABULARY C641205
OMPRESSION*BOLT BERANEK AND NEWMAN INC.*3335/B694*CAMBRIDGE.MASS.OBOLT B641205
ERANEK AND NEWMAN INC. OFFICE OF NAVAL RESEARCH CONTRACT NONR-430(00). 641205
STATUS REPORT. NO.4.1964* 641205

OPTIMAL STIMULUS PRESENTATION STRATEGY FOR A STIMULUS SAMPLING MODEL OF 641206
LEARNING +SDC*KARUSH. W. AND DEAR. R.E.*5000/K18A*SANTA MONICA. CALIF.-641206
SYSTEM DEVELOPMENT CORP.. REPORT NO. 1898. 1964* 641206

TEACHING MATHEMATICS THROUGH THE USE OF A TIME-SHARED COMPUTER H-212+MAS641207
S. BOARD OF EDUC.. TELETYPE. STUDENT INTERFACE*RICHARDSON.J.C.*2100/R523641207
*NOTICE OF RESEARCH PROJECT. SCIENCE INFORMATION EXCHANGE. SMITHSONIAN I641207
NSTITUTION (SUMMARY OF A RESEARCH PROPOSAL SUBMITTED TO U.S. OFFICE OF E641207
DUCATION)* 641207

CONTINUATION OF RESEARCH IN MATHEMATICAL BEHAVIOR THEORY+MATH MODELS. IN650001
FORMATION. REWARD. PDP-1. STANFORD UNIV.*ESTES. W.K.*5000/E79*STANFORD. 650001
CALIF.-STANFORD UNIV.. PROPOSAL TO ONR FOR CONTINUATION OF CONTRACT NONR650001
225(73).1965* 650001

COMMUNICATIONS IMPLICATIONS OF THE PROJECT MAC MULTIPLE-ACCESS COMPUTER 650005
SYSTEM+TRANSMISSION. STUDENT INTERFACE. TIME-SHARING*MILLS.R.C.*3210/M65650005
7*IEEE INTERNATIONAL CONVENTION RECORD. 1965. PART 1. 239-241* 650005

THE COMPILATION OF NATURAL LANGUAGE TEXT INTO TEACHING MACHINE PROGRAMS+650006
TMCOMPILE. TEACH. COMPILER. INTERPRETER*UHR.L.*4 14/U31*PROCEEDINGS. FAL650006
L JOINT COMPUTER CONFERENCE. 1964. 35-44* 650006

MENTOR.A COMPUTER LANGUAGE FOR PROGRAMMED DISCOURSE+BBN.PDP-1. LISP. SOC650007
RATIC SYSTEM. MEDICAL DIAGNOSIS. TYPEWRITER.SCOPE*FEURZEIG. W. AND BOBRO650007
W.D.C.*4102/F426*CAMBRIDGE.MASS.-BOLT BERANEK AND NEWMAN INC.. UNPUBL. 650007
MANUSCRIPT.1965* 650007

IBM1800 DATA ACQUISITION AND CONTROL SYSTEM- SYSTEM SUMMARY*INTERNATIONA650008
L BUSINESS MACHINES CORP.*3516/I61*WHITE PLAINS.N.Y.-IBM. DATA PROCESSIN650008
G DIV.. SYSTEMS REFERENCE LIBRARY FILE NO. 1800. FORM A26-5920-1.UNDATED650008
* 650008

THE DATANET-30 DATA COMMUNICATIONS PROCESSOR+GENERAL ELECTRIC*GENERAL EL650009
ECTRIC CO.*3501/G326*PRODUCT DESCRIPTION AND ADVERTISEMENT DISTRIBUTED B650009
Y GENERAL ELECTRIC CO.. UNDATED* 650009

AN INTRODUCTION TO THE BEHAVIORAL TECHNOLOGY DEPARTMENT+SLATE*WESTINGHOU650010
SE RESEARCH LABORATORIES*3000/W516*ALBUQUERQUE.N.M.-WESTINGHOUSE RESEARC650010

LABORATORIES, BEHAVIORAL TECHNOLOGY DEPT., TECHNICAL PROGRAM INFORMATI650010
N (UNDATED)* 650010

NDIVIDUALIZING INSTRUCTION THROUGH PACING PROCEDURES+AIR,PROGRAM GENERA650013
ION,TELEVISION*GROPPER,G.*6400/G876*AV COMM. REV., 1965, VOL.13,NO.2, 1650013
5-182* 650013

LATO PROGRAM VERBOSE+UNIV.OF ILL.,CSL,INSTRUCTIONAL LOGICS,WORD ASSOCIA650014
ION*HICKS,B.*2000/H631*URBANA,ILL.,UNIV. OF ILL., COORD.SCI.LAB.REP.I-1650014
9, 1965* 650014

OME COMMENTS ON THE ORGANIZATION OF MEN, MACHINES AND CONCEPTS+CYBERNET650015
 MODELS,DATA PROCESSING,EXPERIMENTS*PASK, G.*5 P282*SYSTEM RESEARCH650015
TD., 20, HILL RISE, RICHMOND,SURREY, U.K.* 650015

AN-MACHINE INTERACTION IN ADAPTIVELY CONTROLLED EXPERIMENTAL CONDITIONS650016
CYBERNETIC MODEL*PASK,G.*5000/P282*SYSTEM RESEARCH LTD., 20, HILL RISE,650016
ICHMOND, SURREY, U.K.* 650016

THEORIES OF LEARNING*LEWIS, B.*5000/L673*SYSTEM RESEARCH LTD., 20, HILL650017
ISE, RICHMOND, SURREY, U.K.* 650017

PERATIONAL DESCRIPTION OF THE MASTERTUTOR OF THE SOCRATES SYSTEM+UNIV. 650101
F ILL.,STUDENT INTER-FACE, AUTO-TUTOR, DISPLAY TECHNIQUES, RESPONSE TEC650101
NIQUES*LIPPERT,H.T.*3400/L765*URBANA, ILL.- UNIV. OF ILL., TRAINING RES650101
ARCH LABORATORY, NONR 3985(01) TECH. MEMO.NO.3,1965* 650101

ESIGN AND USE OF INFORMATION SYSTEMS FOR AUTOMATED ON-THE-JOB TRAINING,650102
VOL.4, GRAPHICAL SYMBOLOGY AND LOGIC DIAGRAMS FOR USE AS TRAINING AIDS+650102
SD*DUGGAN, B.C., ROSENBURG, R.C., SHERIDAN, T.B., AND MAYER, SYLVIA R.*650102
101/D866* BEDFORD,MASS.- AIR FORCE SYSTEM COMMAND, DECISION SCIENCES LA650102
ORATORY, L.G. HANSCOM FIELD, TECHNICAL REPORT NO. ESD-TDR-64-234, VOL. 650102
, 1965* 650102

ORDON PASK, CYBERNETICIAN+ADAPTIVE TEACHING MACHINES, SAKI, KEYBOARD O650103
PRATION,MAN-MACHINE COMMUNICATIONS*EYKEN, W. VAN DER*3330/E97*NEW EDUCA650103
ON, 1965, VOL.1, NO.3,17-18* 650103

MPUTER-BASED MATHEMATICS INSTRUCTIONO THE FIRST YEAR OF THE PROJECT+ S650104
NFORD, MATHEMATICS, DECISION LOGIC, PROGRAMMING,OPTICAL DISPLAY, CRT, 650104
YBOARD, AUDIO, ELEMENTARY SCHOOL, STUDENT INTERFACE*SUPPES,P.*3000/S95650104
*BULLETIN OF THE INT'L. STUDY GROUP FOR MATH. LEARNING, 1965, VOL.3, 7650104
2* 650104

ACHING AS A CONTROL ENGINEERING PROCESS+TEACHING MACHINES,ADAPTIVE,DES650105
N,CYBERNETIC,INSTRUCTIONAL LOGIC*PASK,G.*5140/P282*CONTROL, 1965, NOS.650105
AND 2* 650105

IE DEVELOPMENT AND CURRENT STATUS OF COMPUTER BASED INSTRUCTION+EQUIPME650106
,RESEARCH*DICK,W.*1010/D547*AMER. EDUC. RES. J., 1965, VOL. 2, 41-54* 650106

IE SUMERIAN GAME, TEACHING ECONOMICS WITH A COMPUTERIZED P.I. PROGRAM+ 650201
IMULATION*MONCRIEF, B. *2181/M739*PROGRAMED INSTRUCTION, 1965, VOL. 4,650201
0-11* 650201

ATUS REPORT+SUMERIAN GAME, IBM7090,SCIENCE, ECONOMICS, ELEMENTARY SCHO650202
*KING,R.L.*2000/W769*YORKTOWN HEIGHTS, NEW YORKO BOARD OF COOPERATIVE 650202
UCATIONAL SERVICES FOR NORTHERN WESTCHESTER COUNTY, COOPERATIVE RESEAR650202
 PROJECT NO.1948, 1965* 650202

MPUTER-CONTROLLED ECONOMICS GAMES FOR THE ELEMENTARY SCHOOL+SUMERIAN G650203
E, SIERRA LEONE DEV. PROJ. GAME, IBM7090*BOARD OF COOPERATIVE EDUCATI0650203
L SERV,NORTHERN WESTCHESTER COUNTY, NEW YORK*5300/B662*UNPUBLISHED MAN650203
CRIPT,BOCES, NORTHERN WESTCHESTER COUNTY, NEW YORK* 650203

A STUDY OF SAMPLE SIZE IN MAKING DECISIONS ABOUT INSTRUCTIONAL MATERIALS650204
+UI/TRL. DEVELOPING MATERIALS. REJECT FRAMES. ALGEBRA*FRANCKE. GERALD AN650204
D.STOLUROW. LAWRENCE M.*6400/F897*URBANA ILL.OUNIV. OF ILL.. TRAINING RE650204
SEARCH LAB.. TECHNICAL REPORT NO 11. FEB. 1965* 650204

DELAY OF SELF-TESTING IN THREE TYPES OF PROGRAMED TEXT+PREVIEW. REVIEW. 650205
CONFIRMATION*HERSHBERGER. W.A.*4000/H569*J. EDUC. PSYCHOL..1965.VOL 56.N650205
O 1* 650205

TYPOGRAPHICAL CUEING IN CONVENTIONAL AND PROGRAMED TEXTS*HERSHBERGER. W.650206
A. AND TERRY. D.F.*6000/H569A*J. APPL. PSYCHOL.. VOL.49. NO.1. FEB.1965*650206

MAINFEST STRENGTHENING OF CORRECT RESPONSES OF PAIRED-ASSOCIATES UNDER P650207
OSTCRITERION ZERO PER CENT OCCURRENCE OF RESPONSE MEMBERS*GOSS. A.E.*510650207
1/G677A*J. GEN. PSYCHOL.. 1965 VOL.72. 135-144* 650207

COBIS COMPUTER BASED INSTRUCTION SYSTEM+LIGHT PENCIL.MULTIPLE CHOICE.DEG650301
REE OF CERTAINTY*BAKER.J.D.*3331/B167*NEWSLETTER.GREATER BOSTON CHAP. OF650301
THE SOCIETY FOR PROGRAMMED INSTRUCTION.1965.VOL 1.NO4* 650301

TOWARD MORE VERSATILE TEACHING MACHINES+SOCRATIC SYSTEM.BBN*FEURZEIG.W.*650302
3335/F426C*UNPUBL. MANUSCRIPT. BOLT BERANEK AND NEWMAN INC.. CAMBRIDGE. 650302
MASS. SUBMITTED TO COMPUTER AND AUTOMATION FOR PUBLICATION IN MARCH 1965650302
* 650302

AN OPTIMAL STRATEGY FOR THE PRESENTATION OF PAIRED-ASSOCIATE ITEMS+STIMU650304
LUS SAMPLING. SHORT TERM RETENTION. CLASS. SDC*DEAR R.E.. SILBERMAN. H.F650304
.. ESTAVAN. D.P.. AND ATKINSON. R.C.*5101/D245*SANTA MONICA. CALIF.. SYS650304
TEM DEVELOPMENT CORP. TECHNICAL MEMORANDUM NO.TM 1935/101/00.1965* 650304

DESIGN AND USE OF INFORMATION SYSTEMS FOR AUTOMATED ON-THE-JOB TRAINING.650305
VOL.3. EXPERIMENTAL USE OF THREE INSTRUCTIONAL CONCEPTS+ESD.DISCOVERY.GR650305
APHICAL.FLOW DIAGRAM.PHYLOGENIC*BIO-DYNAMICS INC.*6100/B615*BEDFORD.MASS650305
..AIR FORCE SYSTEM COMMAND. DECISION SCIENCES LABORATORY. L.G. HANSCOM F650305
IELD. TECHNICAL DOCUMENTARY REPORT NO.ESD-TR-64-234.1964* 650305

OUTLINE OF PROGRAMMED INTRODUCTION TO ELEMENTARY DEDUCTIVE LOGIC+UNIV. O650306
F ILL..TRL. LOGIC SYLLOGISMS. SOCRATES*TRAIN.RES.LAB.UNIV.OF ILL.*2320/T650306
768*URBANA.ILL.OUNIV.OF ILL..TRAINING RESEARCH LABORATORY. 1965* 650306

THE MIT TECHNICAL INFORMATION PROJECT+SEARCH. LIBRARY*KESSLER.M.M.*2320/650307
K42*PHYSICS TODAY. MARCH 1965. 28-36* 650307

THE SYSTEMS APPROACH.TECHNOLOGY AND THE SCHOOL+BRANCHING. CLASS. TUTORIA650402
L. TIME-SHARING*CARTER. L. AND SILBERMAN.H.F.*3325/C324*SANTA MONICA.CAL650402
IF. SYSTEM DEV. CORP..SDC DOCUMENT NO.SP-2025.1965* 650402

DESIGN AND USE OF INFORMATION SYSTEMS FOR AUTOMATED ON-THE-JOB TRAINING.650403
VOL. V. FINAL REPORT+ESD.GRAPHICAL SYMBOLOGY. CONSOLES. QUERY-REASONIN650403
G. PHYLOGENIC. COMMAND AND CONTROL*BIO-DYNAMICS INC.*6100/B615*BEDFORD.M650403
ASS..AIR FORCE ELECTRONIC SYSTEMS DIVISON. DECISION SCIENCES LABORATORY.650403
TECH. DOC. REP. NO. ESD-TDR-64-234.1965* 650403

SLAVE MEMORIES AND DYNAMIC STORAGE ALLOCATION*WILKES.M.V.*3500/W682*IEEE650405
TRANSACTIONS ON ELECTRONIC COMPUTERS. 1965. VOL EC-14.NO.2.270-271* 650405

STUDY OF COMPUTER POTENTIAL IN HELPING PUPILS LEARN+APPLICATIONS.SYSTEMS650406
.FLORIDA STATE UNIV..IBM YORKTOWN*FLORIDA STATE U*3301/F636*DIG.COMP.NEW650406
S. OFF. OF NAVAL RESEARCH. 1965. VOL.17.NO.2. 31 32* 650406

PLATO II AND III+UNIV.OF ILL..CSL.CATO.INQUIRY TRAINING.REPLAB.TEXT-TEST650407
ER.INSTRUCTIONAL LOGIC.LANGUAGE.ANALYSIS*COORD.SCI.LAB.*3345/C778*DIGITA650407
L COMPUTER NEWSLETTER. OFFICE OF NAVAL RESEARCH. 1965. VOL. 17. NO. 2. 3650407
7-39* 650407

:PERIMENTAL COMPUTER-ASSISTED INSTRUCTION SYSTEM+IBM YORKTOWN.PENN STAT650408
UNIV.*IBM CORP.*3301/161*DIG.COMP.NEWS.. OFF. OF NAVAL RESEARCH.1965. 650408
)L.17. NO. 2. 39-42* 650408

:BERNETIC TESTING+DEGREE OF CERTAINTY. MULTIPLE CHOICE. LIGHT PENCIL. B650501
.NCING. STUDENT INTERFACE. RESPONSE TECHNIQUES. DECISION LOGIC*SHUFORD.650501
.H.*3410/S562*PAPER PRESENTED AT MEETING OF NATIONAL SOCIETY FOR PROGRA650501
IED INSTRUCTION. PHILADELPHIA. PA. 5-8MAY 1965* 650501

IAT THE TALKING TYPEWRITER SAYS+EDISON RESPONSIVE ENVIRONMENT. AUTISTIC650502
IILDREN. READING. TYPING. STUDENT INTERFACE. DISPLAY TECHNIQUES. RESPON650502
: TECHNIQUES*PINES.MAYA*3327/P651*NEW YORK TIMES MAGAZINE. 9 MAY1965* 650502

I COMMUNICATION AND CONTROL IN THE EDUCATIONAL PROCESS+ESD. DEGREE OF B650503
.IEF. CYBERNETIC. RESPONSE TECHNIQUES. DECISION LOGIC. STUDENT INTERFA650503
:*SHUFORD E.H.AND MASSENGILL. H.E.*3400/S562*BEDFORD.MASS.- DECISION SC650503
:NCES LABORATORY. L.G. HANSCOM FIELD. ESD-TR-65 568 (1965)* 650503

'RECT VS INDIRECT ASSESSMENT OF SIMPLE KNOWLEDGE STRUCTURES+ESD. DEGREE650504
)F BELIEF. CYBERNETIC TESTING. INSTRUCTIONAL LOGICS*MASSENGILL.H.E. AND650504
;HUFORD.E.H.*5200/M415*BEDFORD. MASS.O DECISION SCIENCES LABORATORY. L.650504
. HANSCOM FIELD. ESD-TR-65-542(1965).* 650504

DEMONSTRATION HYBIRD COMPUTER FOR REAL-TIME FLIGHT STIMULATION+MASS.IN650601
'. OF TECH..ANALOG-DIGITAL.PDP1*CONNELLY. M.E. AND FEDERAOFF. O.*5300/C650601
52*WRIGHT PATTERSON AFB. OHIO.AEROSPACE MEDICAL DIVISON. AEROSPACE MEDI650601
IL RESEARCH LABORATORIES NO. AMRL-65-97. 1965* 650601

:.OLC HOMES TIED TO COMPUTER CENTER+COMMUNITY CABLE NETWORK. TIME-SHARI650603
;. BROOKS FOUNDATION. MARYLAND. STUDENT INTERFACE*LIPSITZ.L.(ED.)*3000/650603
767*TEACHING AIDS NEWS. 1965 VOL.5. NO.12. 5-8* 650603

;SENTIAL PRINCIPLES OF PROGRAMMED INSTRUCTION+UNIV. OF ILL.. TRL. LINEA650604
PROGRAMMING. ADAPTIVE PROGRAMMING. IDIOGRAPHIC PROGRAMMING. INSTRUCTIO650604
IL LOGICS. SEQUENCE VARIABLES*STOLUROW.L.M.*600 /S876*URBANA. ILL.O UNI650604
. OF ILL.. TRAINING RESEARCH LABORATORY. CONTACT NONR 3985(04)TECH. REP650604
NO.8. JUNE.1965* 650604

:FECTS OF WRITTEN VERBALIZATION AND TIMING OF INFORMATION ON PROBLEM SO650606
/ING IN PROGRAMED LEARNING+HUMRRO. PROGRAMING. PROMPTING. CONFIRMATION.650606
RULE VERBALIZATION*SEIDEL. R.J. AND ROTBERG. IRIS*6300/S458*J. EDUC. PS650606
:HOL.. IN PRESS* 650606

N INFORMATION SYSTEM FOR VOCATIONAL DECISIONS+COUNSELOR*TIEDEMAN.D.V.. 650607
ANDY.E..FLETCHER.W.J..ELLIS.A.B..DAVIS.R.G..AND BOYER.E.G.*2320/T559*PR650607
POSAL SUBMITTED TO THE U.S. COMMISSIONER OF EDUCATION. 1 JUNE 1965 (REV650607
SED 15 SEPT. 1965)* 650607

OMPUTER-BASED INSTRUCTION+UNIV. OF ILL.. SOCRATES. STUDENT INTERFACE. D650701
SPLAY TECHNIQUES. REPONSE TECHNIQUES. INSTRUCTIONAL LOGICS. PROGRAM GEN650701
RATION*STOLUROW.L.M.*3440/S876C*URBANA.ILLO UNIV. OF ILL.. TRAINING RES650701
ARCH LABORATORY. CONTRACT NONR3985(04). REP. NO.9. 1965* 650701

DESCRIPTIVE LIST OF PLATO LESSON PROGRAMS. 196 1965 (REVISED REPORT)+650702
NIV.OF ILL..CSL.SYSTEMS ANALYSIS.INSTRUCTIONAL LOGICS.BIBLIOGRAPHY*LYMA650702
YMAN.ELISABETH. R.*1020/L986*URBANA. ILLINOIS- UNIV. OF ILL.. COORDINAT650702
D SCIENCE LABORATORY. REPORT R-186= 1965* 650702

OMPUTER-ASSITED SOCRATIC INSTRUCTION+SOCRATIC SYSTEM. BBN*BOLT. R.H.*33650703
5/B694*PAPER PRESENTED AT FIRST INTERNATIONAL CONFERENCE AND EXHIBIT ON650703
THE IMPACT OF EDUCATIONAL TECHNOLOGY SPONSORED BY THE AMERICAN MANGEMEN650703
ASSOCIATION.15 JULY 1965* 650703

YSTEMS APPROACH TO INSTRUCTION+UNIV. OF ILL.. TRL.SYSTEMS ANAYSIS.SOCRA650704
ES*3100/S876*URBANA. ILL.O UNIV. OF ILL.. TRAINING RESEARCH LABORATORY.650704

NONR3985(04), TECH. REP. NO.7, JULY, 1965* 650704

AN APPROACH TO THE USE OF COMPUTERS IN THE INSTRUCTIONAL PROCESS AND AN 650705
EVALUATION+PROGRAMMED TEXT, IBM1050, IBM1440, IBM1448, COMPUTER PROGRAMM650705
ING*SCHURDAK, J.J.*7000/S394*YORKTOWN HEIGHTS, NEW YORK- IBM WATSON RESE650705
ARCH CENTER REPORT RC-1432,1965* 650705

PAIRED-ASSOCIATES LEARNING WITH VARYING RELATIVE PERCENTAGES OF OCCURREN650706
CE OF ALTERNATIVE RESPONSE MEMBERS+ INFLUENCE OF INSTRUCTIONS*GOSS,A.E.*650706
J.EXP.PSYCHOL.,1965,VOL 70, NO 1, 51-55* 650706

AN OVERVIEW OF POTENTIALS OF COMPUTER-ASSISTED INSTRUCTION+EDUCATIONAL M650707
ANGEMENT*BOLT, R.H.*1000/B694*CAMBRIDGE,MASS. BOLT BERANEK AND NEWMAN IN650707
C, PAPER PRESENTED AT THE FIRST INTERNATIONAL CONFERENCE AND EXHIBIT ON 650707
THE IMPACT OF EDUCATIONAL TECHNOLOGY, AMERICAN MANAGEMENT ASSOCIATION,19650707
65* 650707

THE DEVELOPMENT AND EVALUATION OF A PROGRAMMING TECHNIQUE FOR RELATING F650709
RAME DIFFICULTY TO THE ABILITY OF THE LEARNER+PROGRAMMED TEXT, ACHIEVEME650709
NT*MOORE,J.W. AND SMITH,W.I.*3610/M821*LEWISBURG,PA.-BUCKNELL UNIV., FIN650709
AL REPORT, USOE TITLE VII, GRANT NO. 7-48-0070-195, 1965* 650709

PLATO II AND PLATO III+UNIV.OF ILL.,CSL,CATO,PLASMA DISCHARGE TUBE,TEXT-650711
TESTER,COMMUNICATION*COORD.SCI.LAB.*3345/C778*DIGITAL COMPUTER NEWSLETTE650711
R, OFFICE OF NAVAL RESEARCH, VOL.17, NO. 3, 20-24* 650711

COMPUTEST- A COMPUTER LANGUAGE FOR INDIVIDUAL TESTING, INSTRUCTION,AND I650712
NTERVIEWING+IBM1620,SPS,INSTRUCTIONAL LOGICS*STARKWEATHER,J.*4104/S795*P650712
SYCHOLOGICAL REPORT, 1965, VOL. 17, 227-237* 650712

FUNCTIONAL SPECIFICATIONS FOR COMPUTER ASSISTED INSTRUCTION SYSTEMS+AUTH650713
OR LANGUAGE,STUDENT RESPONSES, JUSTIFICATION*ZINN, KARL L.*3100/Z77*DETR650713
OIT-AUTOMATED EDUCATION CENTER, 1965 (CHAP. IN GOODMAN,E.,ED., AUTOMATED650713
EDUCATION HANDBOOK)* 650713

COMPUTER-AIDED PROGRAMMED TECHNIQUES IN SUPPORT OF MILITARY INFORMATION 650801
SYSTEM+ESD,TIME-SHARING, BRANCHING, COMPUTER USE, STUDENT INTERFACE, D650801
ISPLAY TECHNIQUES*MAYER, SYLVIA R. AND MORGAN,R.*1000/M468*PROCEEDINGS O650801
F CONFERENCE OF ASSOCIATION FOR COMPUTING MACHINERY,1965* 650801

REINFORCEMENT-TEST SEQUENCES IN PAIRED-ASSOCIATE LEARNING+STANFORD, RESP650802
ONSE LATENCY, ONE-ELEMENT MODEL, STIMULUS FLUCTUATION MODEL*IZAWA, C. AN650802
D ESTES, W.K.*5101/I98*INST. FOR MATHEMATICAL STUDIES IN THE SOCIAL SCIE650802
NCES, STANFORD UNIV., STANFORD, CALIF. TECH. REPORT NO.76, AUGUST 1,196650802
5* 650802

IBM BEGINS COAST TO COAST TEST OF COMPUTER ASSISTED INSTRUCTION+INDUSTRI650803
AL TRAINING,IBM1440,IBM1050,TELEPHONE LINES*AMERICAN SOCIETY FOR TRAININ650803
G AND DEVELOPMENT*3302/A512*TRAIN.DIR.J.,1965,VOL.19,NO.8,66-67* 650803

EXPLORATIONS IN COMPUTER ASSISTED COUNSELING+SDC,INTERVIEW,PHILCO2000, T650804
ELETYPE,TIME-SHARING*COGSWELL, J.F. AND ESTAVAN, D.P.*2320/C677*SANTA MO650804
NICA, CALF.-SYSTEM DEVELOPMENT CORPORATION TECHNICAL MEMORANDUM NO.TM-25650804
82/00/00, 1965* 650804

OPERATIONAL DESCRIPTION OF THE MASTER I/O STATION OF SOCRATES+UNIV. OF I650805
LL./TRL, STUDENT INTER-FACE, DISPLAY TECHNIQUES,RESPONSE TECHNIQUES*LIPP650805
ERT,H.T.*3400/L765A*URBANA, ILL.- UNIV. OF ILL., TRAINING RESEARCH LABOR650805
ATORY, TECHNICAL MEMORANDUM NO.18, 1965.* 650805

GENERAL PURPOSE DISPLAY SYSTEM+SDC,GPDS,DIALOGUE, LUCID,STUDENT INTERFAC650806
E, LANGUAGE*VORHAUS,A.H.*3401/V953*SDC MAGAZINE,1965, VOL.8, NO.8, 1-15*650806

EXPLORATIONS IN COMPUTER ASSISTED COUNSELING+SDC,VOCATIONAL PLANNING,AUT650807

ITED INTERVIEW.EDUCATIONAL PLANNING*COGSWELL.J.*2321-C677*SYSTEM DEVEL650807
IENT CORPORATION. SANTA MONICA. CALIF.. TECHNICAL MEMORANDUM REPORT NO650807
TM-2582-000-00.* 650807

COMPARISON OF TWO STRATEGIES FOR INDIVIDUALIZING FIXED-PACED PROGRAMMED650901
ISTRUCTION+AIR.FIXED PACE.RESPONSE PROMPTING.INSTRUCTIONAL ALTERNATIVE650901
PROGRAMMING*KRESS.G.C..JR. AND GROPPER.G.L.*6210/K92*A PAPER FOR A SYM650901
SIUM. SYSTEMATIC INSTRUCTION.APA ANNUAL CONVENTION.1965.PITTSBURGH.PA.650901
IER. INST. FOR RESEARCH.1965* 650901

IE PRELIMINARY RESULTS ON THE REACTIONS OF STUDENTS TO COMPUTER-ASSIST650902
INSTRUCTION+PENNA.STATE UNIV.. PARTIAL ANSWER PROCESSING. STUDENT CON650902
OLLED PAUSES. IBM1440. IBM YORKTOWN. EVALUATION*WODTKE.KENNETH W.. MIT650902
.. HAROLD E.. BROWN. BOBBY R.*5000/W838*PENNSYLVANIA STATE UNIV.. STAT650902
COLLEGE. PA.0A PAPER FOR A SYMPOSIUM0 SYSTEMATIC INSTRUCTION. APA CONV650902
TION. 1965* 650902

E EVOLVING TIME-SHARING SYSTEM AT DARTMOUTH COLLEGE+GE235. CENTRAL COM650903
TERS. BASIC.ALGOL.TEACH. DIP. EDIT. STUDENT INTERFACE. DISPLAY TECHNIQ650903
S. RESPONSE TECHNIQUES*LOUHNER.K.M.*3210/L812*COMPUTERS AND AUTOMATION650903
SEPTEMBER.1965* 650903

E ROMANCE OF GOOD TEACHING-AND THE TIME-SHARED COMPUTER+DARTMOUTH.EXET650904
. BASIC*BERKELEY. EDMUND C.*4011/B512*COMPUTERS AND AUTOMATION. 1965* 650904

E EFFECTS OF PAIRED STUDENT INTERACTION IN THE COMPUTER TUTORING OF ST650906
ISTICS+IBM/YORK. COSTS*GRUBB. RALPH E.*2105/G885A*INTERNATIONAL BUSINE650906
MACHINES CORPORATION. 112 EAST POST ROAD. WHITE PLAINS. NEW YORK* 650906

R CONFERENCE ON CAI. UNIV. OF ILL.+SOCRATES. PLATO*NEWTON. J.M.*1000/N650907
OMAHA. NEBR.- AUTHOR. UNPUBLISHED MANUSCRIPT. SEPT. 1965 650907

.IDITY JUDGEMENTS OF SYLLOGISMS IN RELATION TO TWO SETS OF INDIVIDUAL 650908
RMS+TRL. SYLLOGISTIC TRAINING.UNIV. OF ILL.. AFFECTIVE TERMS. REASONIN650908
RASE. L.T.*5100/F841*TRAINING RESEARCH LABORATORY. UNIV. ILL). TECHNI650908
. REPORT NO.10. SEPTEMBER.1965* 650908

RATEGIES FOR THE AUTOMATION OF INSTRUCTION+AIR. PROGRAM GENERATION. PR650909
RAMMING*KLAUS. D.J.*6400/K63*TRAINING DIRECTORS JOURNAL.1965.VOL.19. 650909
.9* 650909

I USES COMPUTER TO TRAIN EMPLOYEES IN FOUR SCATTERED LOCATIONS+ERIDGE.650910
BM YORKTOWN. READING. IBM 1440. IBM 1050. AMA CONF.. UNIV. CALIF.. IRV650910
E. MATHEMATICS. NUMBER SQUARING.STATISTICS.HISTORY.ENGLISH*ANON*3301/M650910
.*MANAGEMENT SERVICES. 1965. VOL.2. NO.5.* 650910

ITRIBUTIONS FROM THE INFORMATION SYSTEM SOURCES TO EDUCATIONAL SYSTEM.650911
IPUTER BASED INSTRUCTIONAL SYSTEM+ESD*BAKERJ.D.*1000/B167*DECISION SCI650911
IES LABORATORY.ELECTRONIC SYSTEMS DIVISON.L.G.HANSCOM FIELD.BEDFORD.MA650911
.* 650911

.ISTING OF SOCRATES RESEARCH STUDIES FROM MARCH 1964 TO JUNE 1965+UNIV650912
OF ILL./TRL. BIBLIOGRAPHY*STOLUROW.L.M.*1020/S876*URBANA. ILL.0 UNIV. 650912
ILL.. TRAINING RESEARCH LABORATORY. TECHNICAL MEMORANDUM NO.19. 1965*650912

IPUTER-AIDED TEACHING OF DYNAMIC SYSTEM BEHAVIOR+MIT/MAC. BOND GRAPHS.650913
GINEERING*ROSENBERG.R.C.*2220/R813*CAMBRIDGE. MASS. INST. OF TECH.. PH650913
. THESIS. DEPT. OF MECH. ENGINEERING. 1965* 650913

IPUTER ASSISTANCE FOR INSTRUCTION+ INSTRUCTIONAL MATERIALS.COSTS*ZINN.650915
RL L.*3100/Z77*AUTOMATED EDUCATION NEWSLETTER. OCT. 1965* 650915

I CHILDREN LEARN TO READ+PERCEPTUAL DEVELOPMENT. MATURATION*ELKIND.D.*650916
IO/E37*SCIENCE. 1965. VOL. 149. 1325-1326 (A LETTER WITH A REPLY FROM 650916

ELEANOR J. GIBSON)* 650916

COMPUTER-AIDED INSTRUCTION+BBN, SOCRATIC SYSTEM, MEDICAL DIAGNOSIS, PDP-651001
1, STUDENT INTERFACE, DISPLAY TECHNIQUES, INSTRUCTIONAL LOGICS, SIMULATI651001
ON, PROGRAM GENERATION*SWETS.J.A. AND FEURZEIG.W.*3335/S975*SCIENCE,150,651001
3696, OCTOBER 29, 1965* 651001

IBM'S COMPUTER ASSISTED INSTRUCTION*AMERICAN SOCIETY FOR TRAINING AND DE651002
VELOPMENT*3302/A512A*TRAIN.DIR.J.,1965,VOL 9,NO 10* 651002

COMPUTER-ASSISTED INSTRUCTION IN THE SCHOOLS-POTENTIALITIES, PROBLEMS, A651003
ND PROSPECTS+STANFORD, MATHEMATICS, STUDENT INTERFACE,PROGRAMMING, IBM1651003
50, IBM7090, PDP-1*SUPPES.P.*3000/S959*INST. FOR MATHEMATICAL STUDIES IN651003
THE SOCIAL SCIENCES, TECH. REPORT NO. 81, OCT. 1965. STANFORD CALIF.O ST651003
ANFORD UNIV.* 651003

THE USES OF PLATO A COMPUTER CONTROLLED TEACHING SYSTEM+CSL UNIV.OF ILL.651005
, TEACHING LOGICS*BITZER,D.L., LYMAN, ELISABETH R., AND EASLEY, J.A.* 33651005
45/B624*URBANA, ILL.COORDINATED SCIENCE LABORATORY, UNIV. OF ILL.,REP. R651005
-262, 1965* 651005

PROGRESS REPORT+PLATO,UI/CSL,VERBOSE*COORD.SCI.LAB,UNIV. OF ILL*3345/C77651006
8*URBANA,ILL-UNIV.OF ILL.COORDINATED SCIENCE LAB.PROGRESS REPORT FOR JUN651006
E,JULY,+ AUG,1965- 14 WORK AREAS REPORTED,ONLY PLATO PROJECT ABSTRACTED*651006

IMMEDIATE RETRIEVAL OF VERBAL SERIES AS A FUNCTION OF STIMULUS GROUPING+651007
SERIAL POSITION,ESD*SUMBY,W.H.*5101/S955*BEDFORD,MASS.-U.S. AIR FORCE, 651007
ELECTRONIC SYSTEMS DIV., DECISION SCIENCES LABORATORY, REPORT NO. ESD-TR651007
-64-564, 1965* 651007

PLATO II AND III+UNIV.OF ILL.,CSL,TEXT TESTER,CATO,TUTORIAL,INSTRUCTION651008
AL LOGIC,ENGINEERING*COORD.SCI.LAB.*3345/C778*DIGITAL COMPUTER NEWSLETTE651008
R, OFFICE OF NAVAL RESEARCH, 1965, VOL. 17, NO. 4, 38-39* 651008

COMPUTER-AIDED INSTRUCTION+UNIV.OF LOUISVILLE,DISPLAY TECHNIQUES,IBM1710651009
,ANALOG SIGNALS,TELEVISION TESTING,STUDENT INTERFACE*LOUISVILLE U.*2320/651009
L888*DIG.COMP.NEWS.,OFF. OF NAVAL RESEARCH,1965, VOL. 17, NO. 4, 41* 651009

THOSE WONDERFUL TEACHING MACHINES-OR ARE THEY+COMMUNICATIONS INDUSTRY,PU651101
BLISHERS*FORBES INC*1000/F693*FORBES,1965,VOL 96, NO 9, 58-61* 651101

ARITHMETIC DRILLS AND REVIEW ON A COMPUTER-BASED TELETYPE+STANFORD, ELEM651102
ENTARY SCHOOL*SUPPES.P.,JERMAN.M.,AND GROEN.G.*2107/S959*STANFORD,CALIF.651102
OSTANFORD UNIV. INST. FOR MATH. STUDIES IN THE SOCIAL SCIENCES, PSYCHOL.651102
SERIES, TECH. REP. NO. 83, NOV. 1965* 651102

THE COMPARATIVE EFFECTS OF INDUCTIVE AND DEDUCTIVE SEQUENCES IN PROGRAMM651104
ED INSTRUCTION+STANFORD, STATISTICS, RULE/EXAMPLE, INTELLIGENCE, SEQUENC651104
E VARIABLES,PROGRAMMING*KRUMBOLTZ, J.D. AND YABROFF,W.W.*6100/K94*AMER. 651104
ED. RESEARCH J., 1965, 2,4, 223-235* 651104

COMPUTER-BASED LABORATORY FOR LEARNING AND TEACHING+STANFORD, MATHEMATIC651105
S, READING, SPELLING, LANGUAGE, REINFORCEMENT, SHORT-TERM MEMORY, SYSTEM651105
S, ELEMENTARY SCHOOL*SUPPES.P.,HANSEN.D. AND JERMAN.M.*3000/S959B*STANFO651105
RD,CALIF.O STANFORD UNIV., INST. FOR MATH. STUDIES IN THE SOCIAL SCIENCE651105
S, UNPUBLISHED DOCUMENT, 1965* 651105

REPLAB-A LESSON IN SCIENTIFIC INQUIRY USING THE PLATO SYSTEM+UI/CSL*BITZ651107
ER.D.L.,LYMAN.E.R., AND SUCHMAN.J.R.*6220/B624*URBANA ILL-UNIV OF ILL, C651107
OORDINATED SCIENCE LABORATORY, REPORT R-260, 1965* 651107

COMPUTER ASSISTANCE FOR INSTRUCTION- A REVIEW OF SYSTEMS AND PROJECTS+JU651108
STIFICATION*ZINN,KARL L.*1010/Z77*ANN ARBOR MICH.-THE UNIV. OF MICH.,CEN651108
TER FOR RESEARCH ON LEARNING AND TEACHING, BACKGROUND PAPER PREPARED FOR651108

:DS-STANFORD CONFERENCE ON COMPUTERS IN AMERICAN EDUCATION,NOV.1-3, 196651108
• 651108

HE PLATO TEACHING SYSTEM+UNIV.OF ILL.,CSL*BITZER,D.*3345/B624*AUTOMATED651109
DUCATION NEWSLETTER, 1965, VOL. 1, NO. 2, 13-15* 651109

HE INTERFACE BETWEEN STUDENT AND SUBJECT MATTER UNIV. PITTS. SPECIAL E651204
JCATION, VISUAL COMMUNICATION, AUDITORY COMMUNICATION*GLASER, R.,RAMAGE651204
W.W., AND LIPSON, J.I.*3410/G548*LEARNING RESEARCH AND DEVELOPMENT CEN651204
ER, UNIV. OF PITTS., PITTSBURGH 13, PA.,1965* 651204

HE AMPLIFIED TEACHER- THE GUIDANCE OF HUMAN LEARNING TROUGH CONTROLLING651205
FUNCTIONAL AUTOMATA+SIMULATION, SYSTEMS ANALYSIS*KOPSTEIN, F.F.*1000/K8651205
*PRINCETON, N.J.- EDUCATIONAL TESTING SERVICE, RESEARCH MEMO. RM-65-15,651205
1965* 651205

N FIRST GRADERS LEARN AN ADVANCED PROBLEM SOLVING SKILL *ANDERSON,RICH651206
RD C.*5130/A549*J.OF EDUC.PYSCHOL,1965,VOL 56,NO 6,283-294* 651206

EINFORCEMENT SCHEDULES, SCHOLASTIC APTITUDE, AUTONOMY NEED, AND ACHIEVE651207
ENT IN A PROGRAMED COURSE+PSYCHOLOGY, MOTIVATION*LUBLIN,SHIRLEY CURRAN*651207
500/L929*J. OF EDUCATIONAL PSYCHOL. 1965, VOL. 56, NO. 6, 295-302* 651207

FROM THE DIET OF WORMS TO THE BUCKET OF WORMS',A PROTEST CONCERING EXIS651208
ING DISPLAY DOGMA FOR INFORMATION SYSTEM+ESD, LIGHT PEN, STATPAC, TUTOR651208
NG,*BAKER, J.D.*3410/B167*CHAPT. IN J. SPIEGEL AND D WALKER (EDS.), INF651208
RMATION SYSTEM SCIENCES PROCEEDINGS OF THE SECOND CONGRESS. WASH., D.C651208
-SPARTAN BOOKS, 1965* 651208

ROGRAMED INSTRUCTION-PAST, PRESENT, AND FUTURE+HUMRRO, LITERATURE REVIE651212
, EDUCATIONAL TECHNIQUES, RESEARCH TECHNIQUES*SEIDEL, R.J.*6000/S458* S651212
BMITTED TO J. EDUC. PSYCHOL, DECEMBER 1965* 651212

S-USA CONFERENCE ON COMPUTER AUGMENTED INSTRUCTION-LONDON*NAGAY,J.*1000651213
N147*LONDON, ENGLAND, OFFICE OF NAVAL RESEARCH BRANCH OFFICE, REPORT NO651213
ONRL-C-31-65, 1965* 651213

N EVALUATION OF PROGRAMMED INSTRUCTION FOR TEACHING FACTS AND CONCEPTS+651214
INEAR PROGRAM,LECTURE DISCUSSION, INSTRUCTIONAL ALTERNATIVES,AMRL*JACOB651214
,J.*6210/J17*WRIGHT-PATTERSON AFB, OHIO, AEROSPACE MEDICAL RESEARCH LAB651214
RATORIES REPORT NO. AMRL - TR - 65-222, 1965* 651214

FEW FACTS ABOUT THE WESTINGHOUSE COMPUTER-BASED EDUCATIONAL SYSTEM+EAR660001
HONES, TYPEWRITER, PICTURE TUBE, LIGHT-PENCIL, PHONOGRAPH DISKS, STUDEN660001
INTERFACE, DISPLAY TECHNIQUES, RESPONSE TECHNIQUES*WESTINGHOUSE RESEAR660001
LABORATORIES*3000/W516*PITTSBURGH,PENNA.OWESTINGHOUSE RESEARCH LABORAT660001
RIES, ONE PAGE INFORMATION SHEET, UNDATED* 660001

DMISSIBLE PROBABILITY MEASUREMENT PROCEDURES+DEGREE-OF-BELIEF, TESTING,660002
CORING SYSTEMS, DECISION LOGIC*SHUFORD,E.H., ALBERT,A., AND MASSENGILL,660002
,F.*3400/S562A*PSYCHOMETRIKA, 1966, IN PRESS* 660002

ASIC, A MANUAL+DARTMOUTH TIME SHARING SYSTEM*KEMENY,J.G. AND KURTZ,T.E.660101
4011/K31*HANOVER,N.H.-DARTMOUTH COLLEGE, 1965* 660101

ESEARCH REPORT+EVALUATION, PROGRAMMED INSTRUCTION, EXTERNAL EVALUATION*660102
ARTLEY,J.*7000/H332*NEW EDUCATION, 1966, VOL 2, NO. 1* 660102

OMPUTER ASSISTED INSTRUCTION-A SURVEY OF THE LITERATURE*HICKEY,A.*1000/660104
528*NEWBURYPORT, MASS., ENTELEK, INC. SEMINANNUAL REPORT TO OFFICE OF N660104
VAL RESEARCH, CONTRACT NONR - 4757 (00), 1966* 660104

PPLICATIONS OF COMPUTERS TO RESEARCH ON INSTRUCTION+STANFORD,READING,SP660204

ELLING.CAI EXPERIMENTATION.DRILL.STANFORD CAI SYSTEM*HANSEN.D. N.*2280/H660204
24B*THE STANFORD PROJECT. STANFORD. CALIFORNIA. STANFORD UNIVERSITY. TH660204
E INSTITUTE FOR MATHEMATICAL STUDIES IN THE SOCIAL SCIENCES. PAPER READ660204
AT THE NATIONAL SOCIETY OF COLLEGE TEACHERS OF EDUCATION. FEB. 1966* 660204

ERROR RATE AND VARIETY OF CONTEXTS- IMPORTANT FACTORS IN TEACHING PROBLE660205
M SOLVING VIA PROGRAMED INSTRUCTION+HUMRRO. PROGRAMMING. PROMPTING. CONF660205
FIRMATION. STUDENT DROP-OUT*SEIDEL. R.J.*6100/S458*PAPER TO BE PRESENTED660205
AT APA. SEPTEMBER 1966* 660205

OPERATIONAL SPECIFICATION FOR COMPUTER DIRECTED TRAINING IN INTERMEDIATE660207
QUERY LANGUAGE. MODEL II. FOR SYSTEM 473L. U.S. AIR FORCE HEADQUARTERS+E660207
SD.LIBRASCOPE L3055*CLAPP.D.*2243/C589*AMERICAN INSTITUTE FOR RESEARCH.P660207
ITTSBURGH. PA.* 660207

ILLUSTRATIVE LESSON FOR INITIAL READING. AND ACCOMPANING MACRO STRUCTURE660303
S FOR CAI.+STANFORD. IBM1500 SYSTEM. COURSEWRITER TWO.INSTRUCTIONAL LOGI660303
CS. DECISION LOGICS*HANSEN. D.. ATKINSON. R. AND WILSON. H.*2281/H249*IN660303
STITUTE FOR MATHEMATICAL STUDIES IN THE SOCIAL SCIENCES. STANFORD UNIVER660303
SITY MARCH 15.1966* 660303

ONR CONFERENCE ON CAI LANGUAGES+TELCOMP. COURSE-WRITER. AUTHOR. MENTOR.C660304
ATO. TACT*NEWTON.J.M.*1000/N561A*NEWBURYPORT. MASS.O ENTELEK INC.. 1966*660304

COMPUTER ASSISTED INSTRUCTION IN INITIAL READING STANFORD.SOFTWARE.LANGU660305
AGE.1500 SYSTEM.MATHEMATICAL LEARNING MODELS*ATKINSON.R.*2280/A877*THE S660305
TANFORD PROJECT. STANFORD. CALIFORNIA. STANFORD UNIVERSITY. THE INSTITU660305
TE FOR MATHEMATICAL STUDIES IN THE SOCIAL SCIENCES. TECHNICAL REPORT CO660305
MPLETED IN MARCH. 1966* 660305

COMPUTER BASED ADAPTIVE TRAINING APPLIED TO SYMBOLIC DISPLAYS+ELECTRIC B660306
OAT DIV..DISPLAY COMPLEXITY.ERROR RATE.SIGNAL DETECTION.INSTRUCTIONAL AL660306
TERNATIVES*MIRABELLA.A.*6210/M671*PORT WASHINGTON. N.Y.. U.S.NAVAL TRAIN660306
ING DEVICE CENTER REP. NO. NAVTRADEVCEN 1594-1. 1966* 660306

DIRECT VS. INDIRECT ASSESSMENT OF SIMPLE KNOWLEDGE STRUCTURES+TESTING.GU660307
IDING INSTRUCTION.PROBABILITY MEASUREMENT.ESD*MASSENGILL.H.*5200/M415*BE660307
DFORD. MASS.. DECISION SCIENCES LABORATORY. ELECTRONIC SYSTEMS DIV.. L.G660307
. HANSCOM FIELD. REPORT NO. ESD-TR-65-542. 1965* 660307

THE DEVELOPMENT AND PRESENTATION OF FOUR COURSES BY COMPUTER TELEPROCESS660408
ING+COURSEWRITER.STUDENT INTERFACE.DISPLAY TECHNIQUES.PERFORMANCE MEASUR660408
EMENT.STUDENT VARIABLES.COLLEGE LEVEL.PENN STATE UNIV..IBMYORKTOWN*MITZE660408
L.H.*3301/M685*UNIV.PARK.PA.. PENN STATE UNIV..CAI LAB..INTERIM REPORT.A660408
PRIL.1966* 660408

HUMAN FACTOR PROBLEMS IN COMPUTER GENERATED GRAPHIC DISPLAYS+IDA.INPUT D660409
EVICES.COGNITION*BARMACK.J.*3401/B258*INSTITUTE FOR DEFENSE ANALYSES. FI660409
NAL REPORT. APRIL 1966* 660409

THE LEARNING R - D CENTER+UNIV.OFPITTSBURGH.LRDC*LEARNING R-D*1000-L438*660410
LEARNING RESEARCH AND DEVELOPMENT CENTER. UNIV. OF PITTSBURGH. INTERIM 660410
REPORT. 1966 (DESCRIPTIVE BROCHURE). MAY. 1966* 660410

PROGRAMMING TECHNIQUES FOR THE AUTOMATIC MONITORING OF HUMAN PERFORMANCE660411
+AMRL.SIMULATED TRAINING MISSIONS.PERFORMANCE MEASURES-CRITERIA-EVALUATI660411
ON.SIMULATED MALFUNCTIONS.SKILL LEVEL. ISOLATED SKILLS*KNOOP. PATRICIA*5660411
300-K72* 660411

COMPUTER DIRECTED TRAINING - SYSTEM 473L QUERY LANGUAGE+ESD.DATA STORAGE660413
.MAINTENANCE PROCEDURES.PROGRAM FLOW.CHART.LOGIC STEPS*SCHIFF.J.*2243-S3660413
29*IBM. ROCKVILLE. MARYLAND* 660413

COMPUTEST+TEACHER LANGUAGE.IBM1620.SPS.TESTING.INTERVIEWING.INSTRUCTIONA660501
L LOGICS.SOURCE DOCUMENTS*STARKWEATHER.J.*1036/S795*HAWTHORNE.N.Y..IBM P660501

ROGRAM INFO. DEPT.. 1620 PROGRAM LIBRARY FILE 2. .052 (COMPUTEST MODIFIC660501
ATION LEVEL 1). 1966* 660501

A DESCRIPTION LIST OF PLATO PROGRAMS. 1960-1966+UNIV.OF ILL..CSL.APPLICA660602
TIONS.INSTRUCTIONAL LOGICS.TUTORIAL.INQUIRY*LYMAN.ELIS.*1020/L986*URBANA660602
.ILL.. UNIV. OF ILL.. COORDINATED SCIENCE LAB.. REPORT NO. R-296. 1966* 660602

OFFICE OF EDUCATION SUPPORT FOR EDUCATIONAL TECHNOLOGY*BRIGHT.R.*1000/B8660603
55*WASHINGTON. D.C.. AUTHOR. UNPUBLISHED DRAFT OF COMMENTS AT CONFERENCE660603
ON ENGINEERING SYSTEMS FOR EDUCATIONAND TRAINING. 14 JUNE 1966* 660603

EFFECTS OF DELAY OF INFORMATION FEEDBACK AND LENGTH OF POSTFEEDBACK INTE660604
RVAL ON LINEAR PROGRAMMED LEARNING+FRAME CONSTRUCTION*BOERSMA.F.J.*6100/660604
B672*J. EDUC. PSYCHOL.. 1966. VOL. 57. 140-145* 660604

A STUDY OF TWO METHODS FOR ADAPTING SELF-INSTRUCTIONAL MATERIALS TO INDI660605
VIDUAL DIFFERENCES+SDC.CLASS.INSTRUCTIONAL ALTERNATIVES.BRANCHING.SEQUEN660605
CES.PREDICTED SEQUENCES*MELARAGNO.R.*6210-M517*SYSTEM DEVELOPMENT CORPOR660605
ATION. FINAL REPORT - JUNE 22. 1966* 660605

STATUS REPORT - SUMERIAN GAME. SIERRA LEONE GAME. FREE ENTERPRISE GAME+B660606
OCES.SIMULATION.ECONOMICS.IBM 7090.IBM 1401.SIXTH GRADE*WING.R.L.*2264-W660606
769*IBM 7090 AND 1401 COMPUTER SYSTEMS. BOCES STATUS REPORT. JUNE 1966*660606

STATUS REPORT. PROJECT 2841. JUNE 1966+BOCES.SIMULATION.ECONOMICS.GAMES.660607
INDIVIDUALIZATION.SUMERIAN.SIERRA LEONE.FREE ENTERPRISE*WING.R.L.*3358-W660607
769*BOARD OF COOPERATIVE EDUCATIONAL SERVICES. FIRST SUPERVISORY DISTRIC660607
T. WESTCHESTER COUNTY. NEW YORK. 845 FOX MEADOW ROAD. YORKTOWN. N.Y.. ST660607
ATUS REPORT. JUNE 1966* 660607

QUARTERLY PROGRESS REPORT - JUNE 30. 1966+TEXAS.IBM 1401-1026.SYSTEM UTI660608
LIZATION.ADMINISTRATION*UNIV.OF TEXAS.LAB. FOR CAI*3359/T355*LABORATORY 660608
FOR COMPUTER-ASSISTED INSTRUCTION AT THE UNIVERSITY OF TEXAS. QUARTERLY 660608
PROGRESS REPORT - MARCH - JUNE. 1966* 660608

THE USE OF PROGRAMMED LEARNING AND COMPUTER BASED INSTRUCTION TECHNIQUES660701
TO TEACH ELECTRICAL ENGINEERING NETWORK ANALYSIS UNIV.OF ILL..CSL.PLATO.660701
APPLICATIONS.INSTRUCTIONAL LOGIC.INQUIRY.TUTORIAL*COORD.SCI.LAB.*6220/J6660701
3*URBANA. ILL..UNIV. OF ILL.. COORDINATED SCIENCE LAB. REPORT NO. R-297.660701
1966* 660701

COMPUTER-BASED MATHEMATICS INSTRUCTION - THE SECOND YEAR OF THE PROJECT+660702
STANFORD.INSTRUCTIONAL LOGIC.ELEMENTARY SCHOOL.TELETYPE.ARITHMETIC DRILL660702
*SUPPES. P.*2107/S959*STANFORD.CALIF.. STANFORD UNIV.. INSTITUTE FOR MAT660702
HEMATICAL STUDIES IN THE SOCIAL SCIENCES. ANNUAL REPORT. UNPUBLISHED. J660702
JLY. 1966* 660702

USER'S GUIDE TO PLANIT+SDC.CALC LANGUAGE*FEINGOLD.S.*4105/F299*SYSTEM DE660703
VELOPMENT CORPORATION. SANTA MONICA. CALIF.. TECH. MEMO.-A WORKING PAPER660703
. REPORT NO. TM-3055/000/00.* 660703

THE USE OF PROGRAMMED LEARNING AND COMPUTER BASED INSTRUCTION TECHNIQUES660705
TO TEACH ELECTRICAL ENGINEERING NETWORK ANALYSIS+INSTRUCTIONAL LOGICS.P660705
LATO.INQUIRY LOGIC.TUTORIAL LOGIC*JOHNSON. ROGER*2223/J68*COORDINATED SC660705
IENCE LABORATORY. UNIV. OF ILL.. URBANA. ILL.* 660705

COMBINING RESPONSE MODES IN PROGRAMMED INSTRUCTION+CONSTRUCTED RESPONSE 660805
MODE.MULTIPLE-CHOICE MODE*WILLIAMS. JOANNA*6210/W724*JOURNAL OF EDUC. PS660805
YCH. 1966. VOL. 57. NO. 4. 215-219* 660805

INDIVIDUALIZED INSTRUCTION AND THE COMPUTER - POTENTIAL FOR MASS EDUCATI661001
ON+SDC.APPLICATIONS.IMPERSONAL NATURE.SYSTEM CONFIGURATIONS.TEACHER EDUC661001
ATION.RESEARCH OBJECTIVES*FILEP. R.T.*1000/F481*SYSTEM DEVELOPMENT CORP.661001
.SANTA MONICA. CALIF. 90406* 661001

IM BEGINS COAST TO COAST TEST OF COMPUT	AMERICAN SOCIET	3302/A512	650803
IM'S COMPUTER ASSISTED INSTRUCTION	AMERICAN SOCIET	3302/A512A	651002
STUDY OF DIGITAL COMPUTERS FOR A REAL	ANDERSON,K.W. A	5300/A545	640506
IN FIRST GRADERS LEARN AN ADVANCED PROP	ANDERSON,RICHAR	5130/A549	651206
IM USES COMPUTER TO TRAIN EMPLOYEES IN	ANON	3301/M266	650910
JTOMATIC MESSAGE RETRIEVAL-STUDIES FOR	ARTHUR D. LITTL	4014/L778	631101
OMPUTER ASSISTED INSTRUCTION IN INITIAL	ATKINSON,R.	2280/A877	660305
EART RATE CORRELATES OF INSIGHT+UNIV. O	AVNER,R.	3610/A959	640006
ETECTION OF RATE CHANGES IN PERIODIC PH	AVNER,R.	3600/A959	640007
PPLICATION OF A COMPUTER CONTROLLED AUT	BACHMAN,R.	2160/B124	620002
ORIS COMPUTER BASED INSTRUCTION SYSTEM+	BAKER,J.D.	3331/B167	650301
ONTRIBUTIONS FROM THE INFORMATION SYSTE	BAKERJ.D.	1000/B167	650911
FROM THE DIET OF WORMS TO THE BUCKET OF	BAKER, J.D.	3410/B167	651208
JMAN FACTOR PROBLEMS IN COMPUTER GENERA	BARMACK,J.	3401/B258	660409
HE ROMANCE OF GOOD TEACHING-AND THE TIM	BERKELEY, EDMUN	4011/B512	650904
ESIGN AND USE OF INFORMATION SYSTEMS FO	BIO-DYNAMICS IN	6100/B615	650305
ESIGN AND USE OF INFORMATION SYSTEMS FO	BIO-DYNAMICS IN	6100/B615	650403
LATO - AN AUTOMATIC TEACHING DEVICE+UNI	BITZER,D.	3345/B624	611201
ESCRIPTION AND USE OF A COMPUTER-CONTRO	BITZER,D.	3345/B624	621002
ELF-DIRECTED INQUIRY IN CLINICAL NURSIN	BITZER,MARYANN	2304/B624	630004
LATO A COMPUTER-CONTROLLED TEACHING SYS	BITZER,D.	3345/B624	640406
HE USES OF PLATO A COMPUTER CONTROLLED	BITZER,D.L., LY	3345/B624	651005
EPLAB-A LESSON IN SCIENTIFIC INQUIRY US	BITZER,D.L.,LYM	6220/B624	651107
HE PLATO TEACHING SYSTEM+UNIV.OF ILL.,C	BITZER,D.	3345/B624	651109
OMPUTER-CONTROLLED ECONOMICS GAMES FOR	BOARD OF COOPER	5300/B662	650203
APACITY OF THE PLATO II SYSTEM USING TH	BOBOTEK,H.	3500/B663	620003
FFECTS OF DELAY OF INFORMATION FEEDBACK	BOERSMA,F.J.	6100/B672	660604
HE SOCRATIC SYSTEM, A COMPUTER SYSTEM T	BOLT BERANEK AN	3335/B694	641205
OMPUTER-ASSITED SOCRATIC INSTRUCTION+SO	BOLT, R.H.	3335/B694	650703
N OVERVIEW OF POTENTIALS OF COMPUTER-AS	BOLT, R.H.	1000/B694	650707
ROBLEMS AND PROSPECTS OF TEACHING WITH	BRAUNFELD,P.G.	3340/B825	620802
HE USE OF AN AUTOMATIC COMPUTER SYSTEM	BRAUNFIELD, P.G	3345/B825	620901
FFICE OF EDUCATION SUPPORT FOR EDUCATIO	BRIGHT,R.	1000/B855	660603
HE COMPUTER AS AN INSTRUCTIONAL TOOL, A	BUSHNELL, D.D.	1000/B979	640203
ENDIX G-20 INSTALLATION+REMOTE STATIONS	CARNEGIE INSTIT	3535/C280	610701
OMPUTERS, THEIR IMPACT ON INSTRUCTION,	CARTER,L.F	3000/C324	640603
HE SYSTEMS APPROACH,TECHNOLOGY AND THE	CARTER, L. AND	3325/C324	650402
NEW CONCEPT IN ARTIFICIAL INTELLIGENCE	CHOISSOR,J.P. A	5140/C546	630502
EVELOPMENT AND EVALUATION OF A SELF-INS	CLAPP,D.J.,YENS	3326/C539	641203
PERATIONAL SPECIFICATION FOR COMPUTER D	CLAPP,D.	2243/C589	660207
XPLORATIONS IN COMPUTER ASSISTED COUNSE	COGSWELL, J.F.	2320/C677	650804
XPLORATIONS IN COMPUTER ASSISTED COUNSE	COGSWELL,J.	2321-C677	650807
EW SOLUTIONS TO IMPLEMENTING INSTRUCTIO	COGWELL, J.F.,	3100/C677	640303
DEMONSTRATION HYBRID COMPUTER FOR REAL	CONNELLY, M.E.	5300/C752	650601
LATO 2 +UNIV. OF ILL., TIME-SHARING, IL	COORDINATED SCI	3345/C778A	620401
LATO I+STUDENT PERF.	COORDINATED SCI	3345/C778B	620702
LATO 2 AND 3+UNIV. OF ILL., INQUIRY TRA	COORDINATED SCI	3345/C778C	640401
LATO 1 AND 2+UNIV. OF ILL. INQUIRY TRAI	COORDINATED SCI	DIGITAL CO	640702
LATO 2 AND 3+REPLAB, PROOF, CATO, CDC16	COORDINATED SCI	3345/C778E	641001
PROPOSAL TO EXTEND CONTACT DA 28043 AM	COORDINATED SCI	3345/C778	641202
LATO II AND III+UNIV.OF ILL.,CSL,CATO,I	COORD.SCI.LAB.	3345/C778	650407
LATO II AND PLATO III+UNIV.OF ILL.,CSL,	COORD.SCI.LAB.	3345/C778	650711
PROGRESS REPORT+PLATO,UI/CSL,VERBOSE	COORD.SCI.LAB,U	3345/C778	651006
LATO II AND III+UNIV.OF ILL.,CSL,TEXT	COORD.SCI.LAB.	3345/C778	651008

THE USE OF PROGRAMMED LEARNING AND COMPU	CCORD.SCI.LAB.	6220/J68	660701
PRESENT STATUS AND FUTURE PROSPECTS OF C	COULSON.J.E.	3325/C855	640403
COMPUTER BASED SYSTEMS-THE NEW RESEARCH	DAVIS.D.J..AND	3000/D249	641106
SOULUTIONS FOR OPTIMAL DESIGNS OF STOCHA	DEAR. R.E.	5000/D285	640906
AN OPTIMAL STRATEGY FOR THE PRESENTATION	DEAR R.E.. SILB	5101/D245	650304
THE DEVELOPMENT AND CURRENT STATUS OF CO	DICK.W.	1010/D547	650106
DESIGN AND USE OF INFORMATION SYSTEMS FO	DUGGAN. B.C.. R	3401/D866	650102
A PLATO PROGRAM FOR INSTRUCTION AND DATA	EASLEY.J..GELDE	2103/E13	640104
CURRENT STATUS OF THE TECHNOLOGY OF TRAI	ECKSTAND. G.A.	1000/E19	640903
SYSTEM DESIGN FOR A CONTINUOUS PROGRESS	EGBERT. R.L.. C	3100/E28	640202
HOW CHILDREN LEARN TO READ+PERCEPTUAL DE	ELKIND.D.	2700/E37	650916
CONTINUATION OF RESEARCH IN MATHEMATICAL	ESTES. W.K.	5000/E79	650001
A PROGRAM FOR THE SOLUTION OF A CLASS OF	EVANS. T.G.	5200/E92	641103
GORDON PASK. CYBERNETICIAN+ADAPTIVE TEAC	EYKEN. W. VAN D	3330/E97	650103
COMPUTER SIMULATION OF HUMAN BEHAVIOUR+R	FEIGENBAUM. E.A	5200/F297	640505
USER'S GUIDE TO PLANIT+SDC.CALC LANGUAGE	FEINGOLD.S.	4105/F299	660703
THE SOCRATIC SYSTEMO A COMPUTER SYSTEM F	FEURZEIG. W.. H	3335/F426B	631001
THE PDP-1 COMPUTER AS A TEACHING AID IN	FEURZEIG. W.	3520/T426	640004
THE COMPUTER THAT TALKS LIKE A TEACHER+S	FEURZEIG.W.	3335/F426A	640503
A CONVERSATIONAL TEACHING MACHINE+BBN. S	FEURZEIG.W.	3335/F426F	640601
THE SOCRATIC SYSTEM. A COMPUTER SYSTEM T	FEURZEIG. W.	3335/F426E	640803
CONTINUED REARCH ON THE SOCRATIC SYSTEM.	FEURZEIG. W.	3335/F426D	640804
COMPUTER-AIDED TEACHING IN MEDICAL DIAGN	FEURZEIG. W.. M	2161/F426	640805
THE COMPUTER AS AN EDUCATOR+SOCRATIC SYS	FEURZEIG. W.	3335/F426	640904
MENTOR.A COMPUTER LANGUAGE FOR PROGRAMME	FEURZEIG. W. AN	4102/F426	650007
TOWARD MORE VERSATILE TEACHING MACHINES+	FEURZEIG.W.	3335/F426C	650302
INDIVIDUALIZED INSTRUCTION AND THE COMPU	FILEP. R.T.	1000/F481	661001
STUDY OF COMPUTER POTENTIAL IN HELPING P	FLORIDA STATE U	3301/F636	650406
THOSE WONDERFUL TEACHING MACHINES-OR ARE	FORBES INC	1000/F693	651101
A STUDY OF SAMPLE SIZE IN MAKING DECISIO	FRANCKE. GERALD	6400/F897	650204
VALIDITY JUDGEMENTS OF SYLLOGISMS IN REL	FRASE. L.T.	5100/F841	650908
INVESTIGATION INTO THE SPECIAL PROGRAMMI	FREDKIN.E.	3000/F852	630501
GUIDEBOOK TO SIMULATED STATISTICAL INFER	FRYE. C.G.	2106/F948	640002
THE DATANET-30 DATA COMMUNICATIONS PROCE	GENERAL ELECTRI	3501/G326	650009
AN EVALUATION OF MULTIPLE TRACKS IN A LI	GLASER. ROBERT.	6210/G648	641002
THE INTERFACE BETWEEN STUDENT AND SUBJEC	GLASER. R..RAMA	3410/G548	651204
A PROPOSAL FOR A NATIONAL CONFERENCE ON	GLAZER. R.	1000/G553	640101
COMPUTER-BASED INSTRUCTIONO TODAY AND TO	GOODMAN. L.S.	3400/G653	640404
MAINFEST STRENGTHENING OF CORRECT RESPON	GOSS. A.E.	5101/G677A	650207
PAIRED-ASSOCIATES LEARNING WITH VARYING	GOSS.A.E.	J.EXP.PSYC	650706
INDIVIDUALIZING INSTRUCTION THROUGH PACI	GROPPER.G.	6400/G876	650013
COMPUTER TUTORING IN STATISTICS+COURSEWR	GRUBB. R.E. AND	2105/G885	640302
THE EFFECTS OF PAIRED STUDENT INTERACTIO	GRUBB. RALPH E.	2105/G885A	650906
APPLICATIONS OF COMPUTERS TO RESEARCH ON	HANSEN.D. N.	2280/H248	660204
ILLUSTRATIVE LESSON FOR INITIAL READING.	HANSEN. D.. ATK	2281/H249	660303
RESEARCH REPORT+EVALUATION. PROGRAMMED I	HARTLEY.J.	7000/H332	660102
DELAY OF SELF-TESTING IN THREE TYPES OF	HERSHBERGER. W.	4000/H569	650205
TYPOGRAPHICAL CUEING IN CONVENTIONAL AND	HERSHBERGER. W.	6000/H569A	650206
THE LOGICAL BASIS OF TEACHING 1. THE EF	HICKEY. A.E. AN	6100/H628	640103
PLATO PROGRAM VERBOSE+UNIV.OF ILL..CSL.I	HICKS.B.	2000/H631	650014
COMPUTER ASSISTED INSTRUCTION-A SURVEY O	HICKEY.A.	1000/H628	660104
EXPERIMENTAL COMPUTER-ASSISTED INSTRUCTI	IBM CORP.	3301/I61	650408
HIGHSPEED DOCUMENT PERUSAL+IBM/YORKTOWN	INTERNATIONAL B	2320/I61	620501
IBM1401 OR IBM1440 OPERATING SYSTEMO COM	INTERNATIONAL B	3510/I61	640001
IBM1800 DATA ACQUISITION AND CONTROL SYS	INTERNATIONAL B	3516/I61	650008

REINFORCEMENT-TEST SEQUENCES IN PAIRED-A	IZAWA, C. AND E	5101/I98	650802
VALUATION OF PROGRAMMED INSTRUCTION	JACOBS,J.	6210/J17	651214
USE OF PROGRAMMED LEARNING AND COMPU	JOHNSON, ROGER	2223/J68	660705
IAC-N- A TUTORIAL REPORT+PROGRAMMING	KALLANDER,J.W.	4300/K14	630601
MAL STIMULUS PRESENTATION STRATEGY F	KARUSH, W. AND	5000/K18	641105
MAL STIMULUS PRESENTATION STRATEGY F	KARUSH, W. AND	5000/K18A	641206
XPERIMENTAL EVALUATION OF THE ROLE O	KAUFMAN, R.A.	6210/K21	630102
C, A MANUAL+DARTMOUTH TIME SHARING S	KEMENY,J.G. AND	4011/K31	660101
MIT TECHNICAL INFORMATION PROJECT+SE	KESSLER,M.M.	2320/K42	650307
NCED LANGUAGE PROCESSING PROCEDURES+	KEYSER, S. J.	4014/K44	630902
US REPORT+SUMERIAN GAME, IBM7090,SCI	KING,R.L.	2000/W769	650202
TEGICS FOR THE AUTOMATION OF INSTRUC	KLAUS, D.J.	6400/K63	650909
RAMMING TECHNIQUES FOR THE AUTOMATIC	KNOOP, PATRICIA	5300-K72	660411
PROBLEMS IN INFORMATION SCIENCE WIT	KOCHEN,M.	1000/K76	640405
AMPLIFIED TEACHER- THE GUIDANCE OF H	KOPSTEIN, F.F.	1000/K83	651205
MPARISON OF TWO STRATEGIES FOR INDIV	KRESS,G.C.,JR.	6210/K92	650901
COMPARATIVE EFFECTS OF INDUCTIVE AND	KRUMBOLTZ, J.D.	6100/K94	651104
LEARNING R - D CENTER+UNIV.OFPITTSBU	LEARNING R-D	1000-L438	660410
ATISTICAL OPTIMIZATION OF SEARCH TIM	LEIFER,P.L.	3000/L525	640106
ORIES OF LEARNING	LEWIS, B.	5000/L673	650017
O II A MULTIPLE-STUDENT COMPUTER CON	LICHTENBERGER,W	3345/L699	620001
RATIONAL DESCRIPTION OF THE MASTERTUT	LIPPERT,H.T.	3400/L765	650101
RATIONAL DESCRIPTION OF THE MASTER I/	LIPPERT,H.T.	3400/L765A	650805
100 HOMES TIED TO COMPUTER CENTER+COM	LIPSITZ,L.(ED.)	3000/L767	650603
EVOLVING TIME-SHARING SYSTEM AT DART	LOUHNER,K.M.	3210/L812	650903
PUTER-AIDED INSTRUCTION+UNIV.OF LOUIS	LOUISVILLE U.	2320/L888	651009
FORCEMENT SCHEDULES, SCHOLASTIC APTI	LUBLIN,SHIRLEY	6500/L929	651207
SCRIPTIVE LIST OF PLATO LESSON PROGR	LYMALYMAN,ELISA	1020/L986	650702
SCRIPTION LIST OF PLATO PROGRAMS, 19	LYMAN,ELIS.	1020/L986	660602
ROLE OF COMPUTERS IN EDUCATION+CLASS	MACDONALD, N.	3000/M135	640304
RAL PURPOSE DIGITAL COMPUTERS FOR EN	MACGOWAN,R.A. A	3500/M140	610101
ATIVE FEEDBACK IN AUTOMATED INSTRUCT	MAGER,R.F. AND	6210/M191	630901
PUTER BASED INSTRUCTION-INTRODUCTION	MAHER,A.	3301/M214	640307
MPARISON OF TWO AUTOMATED TEACHING P	MALPASS,L.F., G	6210/M259	630701
PUTER-AIDED TEACHING+MIT, CIVIL ENGIN	MASSACHUSETTS I	2241/M414	640301
ECT VS INDIRECT ASSESSMENT OF SIMPLE	MASSENGILL,H.E.	5200/M415	650504
ECT VS. INDIRECT ASSESSMENT OF SIMPLE	MASSENGILL,H.	5200/M415	660307
IMUM TEACHING PROCEDURES DERIVED FROM	MATHESON,J.E.	5200/M427	640806
AN ENGINEERING IN THE DESIGN OF INSTR	MAYER, SYLVIA R	3100/M468	640902
PUTER-AIDED PROGRAMMED TECHNIQUES IN	MAYER, SYLVIA R	1000/M468	650801
TUDY OF TWO METHODS FOR ADAPTING SELF	MELARAGNO,R.	6210-M517	660605
MUNICATIONS IMPLICATIONS OF THE PROJE	MILLS,R.C.	3210/M657	650005
PUTER BASED ADAPTIVE TRAINING APPLIED	MIRABELLA,A.	6210/M671	660306
DEVELOPMENT AND PRESENTATION OF FOUR	MITZEL,H.	3301/M685	660408
SUMERIAN GAME, TEACHING ECONOMICS WI	MONCRIEFF, B.	2181/M739	650201
TED-A REACTIVE TYPEWRITER+LIBRARY, CA	MOOERS,C.N.	3400/M817	621001
DEVELOPMENT AND EVALUATION OF A PROG	MOORE,J.W. AND	3610/M821	650709
USA CONFERENCE ON COMPUTER AUGMENTED	NAGAY,J.	1000/N147	651213
IMAL STRATEGIES AND HUMAN BEHAVIOR IN	NAKAHARA,J. AND	5130/N163	640204
CONFERENCE ON CAI, UNIV. OF ILL.+SOC	NEWTON, J.M.	1000/N561	650907
CONFERENCE ON CAI LANGUAGES+TELCOMP,	NEWTON,J.M.	1000/N561A	660304
HNICAL AIDS TO CREATIVE THOUGHT (PROJ	OETTINGER,A.C.	3401/028	640605
ORMATION SYSTEMS SUMMARIES+ONR, COMMU	OFFICE OF NAVAL	1020/032	630702
PUTERS IN EDUCATION- A REFERENCE GUID	PACKER,R.E.	1020/P119	640305
TEACHING MACHINE AS A CONTROL MECHAN	PASK,G.	5140/P282	600601

LEARNING MACHINES+CONDITIONAL PROBABILIT	PASK,GORDON	5000-P282	630005
RESEARCH ON CYBERNETIC INVESTIGATION OF	PASK,G.	5140/P277	6310 2
SOME COMMENTS ON THE ORGANIZATION OF MEN	PASK, G.	5000-P282	650015
MAN-MACHINE INTERACTION IN ADAPTIVELY CO	PASK,G.	5000/P282	650016
TEACHING AS A CONTROL ENGINEERING PROCES	PASK,G.	5140/P282	650105
WHAT THE TALKING TYPEWRITER SAYS+EDISON	PINES,MAYA	3327/P651	650502
AN EXECUTIVE PROGRAM FOR MULTIPLE CONSOL	PRYWES,N.W. AND	3210/P973	640308
DESIGN OF A REMOTE DISPLAY CONSOLE+MIT/E	RANDA,G.C.	3401/B186	620201
SIR, A COMPUTER FOR SEMANTIC INFORMATION	RAPHAEL,B.	4014/R217	640604
SEQUENTIAL DECISION-MAKING IN A COMPUTER	RAPOPORT,A.	5000/R219	640703
THE IBM RESEARCH CENTER TEACHING MACHINE	RATH,G.J., ANDE	3001/R234	590001
REPETITION AND SPACED REVIEW N PROGRAMS	RENOLDS,J.H., G	6210/R462A	641204
LEARNING SET FORMATION IN PROGRAMED INST	REYNOLDS,J.H.,	5110/R462	641104
TEACHING MATHEMATICS THROUGH THE USE OF	RICHARDSON,J.C.	2100/R523	641207
PRELIMINARY RESEARCH ON THE TAXONOMY OF S	RODERBURG,T.K.,	6000/R688	641102
AN ATTEMPT TO FIND AN A PRIORI MEASURE O	ROSEN, ELLEN F.	6300/R813	640704
COMPUTER-AIDED TEACHING OF DYNAMIC SYSTE	ROSENBERG,R.C.	2220/R813	650913
SOME CONJECTURES ABOUT INSPECTION BEHAVI	ROTHKOPF,E.Z	5120/R845	630103
AN INFORMATION SYSTEMS APPROACH TO EDUCA	RUANS, D.G.	3325/R988	630903
THE APPLICATION OF PROGRAMMED INSTRUCTIO	RYANS,D.G.	3100/R988	630201
COMPUTER DIRECTED TRAINING - SYSTEM 473L	SCHIFF,J.	2243-S329	660413
TEACHING MACHINES AND PROGRAMMED LEARNING	SCHULTZ,A.A.	1010/S387	640201
AN APPROACH TO THE USE OF COMPUTERS IN T	SCHURDAK, J.J.	7000/S394	650705
EFFECTS OF WRITTEN VERBALIZATION AND TIM	SEIDEL, R.J. AN	6300/S458	650606
PROGRAMED INSTRUCTION-PAST, PRESENT, AND	SEIDEL, R.J.	6000/S458	651212
ERROR RATE AND VARIETY OF CONTEXTS- IMPO	SEIDEL, R.J.	6100/S458	660205
DESIGN AND USE OF INFORMATION SYSTEMS FO	SHERIDAN,T.R. A	3000/S552	631202
DESIGN AND USE OF INFORMATION SYSTEMS FO	SHERIDAN,T.R. A	3100/S552	640105
CYBERNETIC TESTING+DEGREE OF CERTAINTY,	SHUFORD,E.H.	3410/S562	650501
ON COMMUNICATION AND CONTROL IN THE EDUC	SHUFORD E.H.AND	3400/S562	650503
ADMISSIBLE PROBABILITY MEASUREMENT PROCE	SHUFORD,E.H., A	3400/S562A	660002
RESEARCH IN MAN-MACHINE COOPERATIVE SYST	SMALLWOOD,R.D.	3100/S635	641201
COMPUTEST- A COMPUTER LANGUAGE FOR INDIV	STARKWEATHER,J.	4104/S795	650712
COMPUTEST+TEACHER LANGUAGE,IBM1620,SPS,T	STARKWEATHER,J.	1036/S795	660501
COMPARATIVE STUDIES OF PRINCIPLES FOR PR	STOLUROW,L.M. A	6000/S876A	631201
PROBLEMS, PROCEDURES, PITFALLS, AND PROM	STOLUROW,L.M.	8000/S876	640402
RESEARCH RELATING TO THE TRL SYSTEM FOR	STOLUROW,L.M.	3340/S876	640602
PILOT STUDIES OF PRINCIPLES OF PROGRAMMI	STOLUROW,L.M.,	6000/S876B	640701
A MODEL AND CYBERNETIC SYSTEM FOR RESEAR	STOLUROW,L.M.	3440/S876A	640901
LETTER REPORT, PROGRESS OF WORK ON ONR C	STOLUROW,L.M.	3340/S876	641101
ESSENTIAL PRINCIPLES OF PROGRAMMED INSTR	STOLUROW,L.M.	6000/S876	650604
COMPUTER-BASED INSTRUCTION+UNIV. OF ILL.	STOLUROW,L.M.	3440/S876C	650701
SYSTEMS APPROACH TO INSTRUCTION+UNIV. OF	STOLUROW,L.M.	3100/S876	650704
A LISTING OF SOCRATES RESEARCH STUDIES F	STOLUROW,L.M.	1020/S876	650912
AGENERALIZED TEACHING MACHINE DECISION S	STROLLO, T.R.	2281/S919	640504
IMMEDIATE RETRIEVAL OF VERBAL SERIES AS	SUMBY,W.H.	5101/S955	651007
MODERN LEARNING THEORY AND THE ELEMENTOR	SUPPES,P.	5000/S959	640306
COMPUTER-BASED MATHEMATICS INSTRUCTIONO	SUPPES,P.	3000/S959A	650104
COMPUTER-ASSISTED INSTRUCTION IN THE SCH	SUPPES,P.	3000/S959	651003
ARITHMETIC DRILLS AND REVIEW ON A COMPUT	SUPPES,P.,JERMA	2107/S959	651102
COMPUTER-BASED LABORATORY FOR LEARNING A	SUPPES,P.,HANSE	3000/S959B	651105
COMPUTER-BASED MATHEMATICS INSTRUCTION -	SUPPES, P.	2107/S959	660702
SKETCHPAD-A MANMACHINE GRAPHICAL COMMUNI	SUTHERLAND,I.E.	3400/S966	630104
LEARNING TO IDENTIFY NONVERBAL SOUNDSOAN	SWETS,J.A.,MILL	2303/S975	620601
COMPUTER-AIDED INSTRUCTION+BBN, SOCRATIC	SWETS,J.A. AND	3335/S975	651001

AUTOMATIC LANGUAGE ANALYSIS+NATURAL LANG	THORNE,J.P.	4014/T496	621201
AN INFORMATION SYSTEM FOR VOCATIONAL DEC	TIEDEMAN,D.V.,	2320/T559	650607
OUTLINE OF PROGRAMMED INTRODUCTION TO EL	TRAIN.RES.LAB.U	2320/T768	650306
PATTERN RECOGNITION COMPUTERS AS MODELS	UHR,L.	5200/U31	630105
THE COMPILATION OF NATURAL LANGUAGE TEXT	UHR,L.	4014/U31	650006
QUARTERLY PROGRESS REPORT - JUNE 30, 196	UNIV.OF TEXAS.L	3359/T355	660608
GENERAL PURPOSE DISPLAY SYSTEM+SDC,GPDS,	VORHAUS,A.H.	3401/V953	650806
COMPUTER SIMULATIONS OF A PERCEPTUAL LEA	VOSSLER,C.	5200/U31	620803
MULTIPLE PROCESSING TECHNIQUES+SOLOMON 2	WESTINGHOUSE DE	3200/W516	640606
AN INTRODUCTION TO THE BEHAVIORAL TECHNO	WESTINGHOUSE RE	3000/W516	650910
A FEW FACTS ABOUT THE WESTINGHOUSE COMPU	WESTINGHOUSE RE	3000/W516	660001
SLAVE MEMORIES AND DYNAMIC STORAGE ALLOC	WILKES,M.V.	3500/W682	650405
COMBINING RESPONSE MODES IN PROGRAMMED I	WILLIAMS, JOANN	6210/W724	660805
STATUS REPORT - SUMERIAN GAME, SIERRA LE	WING,R.L.	2264-W769	660606
STATUS REPORT, PROJECT 2841, JUNE 1966+B	WING,R.L.	3358-W769	660607
SOME PRELIMINARY RESULTS ON THE REACTION	WODTKE,KENNETH	5000/W838	650902
A TIME-SHARING SYSTEM FOR THE PDP1 COMPU	YATES,J.E.	3210/Y31	620703
FUNCTIONAL SPECIFICATIONS FOR COMPUTER A	ZINN, KARL L.	3100/Z77	650713
COMPUTER ASSISTANCE FOR INSTRUCTION+ INS	ZINN,KARL L.	3100/Z77	650915
COMPUTER ASSISTANCE FOR INSTRUCTION- A R	ZINN,KARL L.	1010/Z77	651108

APPENDIX

CAI PROGRAMS

Generalities

001.42	REPLAB	Scientific inquiry lesson	P65-0011
025.5	LIBUSE	Introduction to use of library	P65-0028

Psychology

150		Six psychology quizzes	P66-1030
150.13		Psychology	P66-1003
150.194 3	PSY317	Introductory statistics for behavioral sciences	P66-0624
153.152	CEWCODE	Paired-associate learning program	P65-0002
153.23	VRBADV	Osgood's theory of meaning	P65-0037
153.23	CONCEPT	Concept attainment program	P65-0036
157.9	SENCOM	Sentence completion presentation via COURSEWRITER	P66-0625
158	KEYSET 1	Keyset configuration study	P65-0038

Social sciences

301.1	EMPATHY	A program to develop teacher sensitivity to student communication	P66-0618
301.4	TALK	Demonstration of group interaction possibilities on PLATO	P65-0017
301.4	GIN-1	Program for group-interaction studies, internation simulation and security-game studies	P65-0019

Statistical method and statistics (See also 519)

311	SIMIN	Simulated statistical inference program	P64-0003
311		Introductory statistics for students in psychology and education	P65-0008
311		Psychological statistics	P66-1005

Economics

330.1		Sumerian Game	P66-0703
330.1		Free Enterprise Game	P66-0702
330.1		Sierra Leone Game	P66-0704
338.4		Engineering economics	P66-0114
338.47	ENGECON	Engineering economics	P65-0002

Public administration

350	HEALTHED	Health education	P66-1018
355.82	EYBOL	A missile orientation training program	P66-0706

Education

370	TEACH	A general purpose monitor	P66-1205
370.15	"ACB"	Educational psychology, classroom behavior	P66-1010
370.15		Educational psychology	P66-1025
371.1	PUNCH	Course space on to which intermediate materials may be stored for punching	P66-0623
371.26		Educational measurement	P66-1107
371.26		Educational measurement	P66-0802
371.26		Mystery problem	P66-0301
371.26	QUIZ 3	General purpose quiz logic; content free	P66-1032
371.26	QUIZ	General purpose quiz logic; content free	P66-1031
371.26	MYSTERY	Decision-making exercise	P66-1023
371.32	TEXT EDIT	Tutorial exercise	P65-0041
371.32	TESTDOPE	Inquiry logic exercise	P65-0039
371.32	TEXT TESTER	Tutorial exercise	P65-0040
371.33		Emphasis on partial answer feedback	P66-1104
371.33		Emphasis on keyword function	P66-1105
371.33		Paired Associates Test	P66-1106
371.394 4	TEACHER	Description of operation of PLATO system	P65-0012
371.4	COAG	Computer-assisted occupational guidance	P66-1112
371.4	EMPATHY	A program to develop counselor sensitivety to clients	P66-0617
372.4		CAI initial reading project	P65-0043
372.4		Stanford-Brentwood Computer-Assisted Instruction	P66-0012
372.63	SPELLING	Spelling instruction for grades 2-6	P65-0001
372.63	SPELLING	Spelling instruction for secondary school students	P66-1108

Linguisitics

411	ALPHABET	Alphabet instruction for very young children	P65-0010
415	VERBOSE	Word chain generation by free association	P65-0018

Germanic languages

431	GERMAN	Reading German	P66-0619

Italic languages

471		Syntaxe et semantique de la preposition in en Latin	P66-0010

Mathematics

500		Scientific notation	P66-0106
502		Working with units	P66-0107
510	PROOF	Mathematical problem-solving	P65-0016
510	SEQUENCES	Lesson on recursive definition	P65-0026

510	ZOO	Second grade math lesson	P65-0021
510	MODMATH 1	Modern mathematics	P65-0003
510		Modern mathematics	P66-0110
510		Test development and studies of quantitative aptitudes	P65-0029
510		Introductory secondary mathematics	P65-0031
510	PROSOL	Heuristic problem solving	P66-0622
510	PIE	To obtain an approximate value for	P66-1204
510	TRAP	To evaluate a given integral by the trapazoid rule	P66-1203
510	SINE	To approximate sin (x) by taking M terms of the Taylor series (around X=O)	P66-1202
510	DIFFEQ	To find that solution of the differential equation u'=f (x, y) which passes through the poing (a, y_0)	P66-1201
510.2		Significant figures	P66-0103
510.783 4		Introduction to automatic digital computing	P65-0020
510.783 4		Introduction to computer programming	P65-0034
510.783 4		FORTRAN programming	P65-0033
511		Arithmetic drill for sixth and seventh grades	P65-0030
511.076		Arithmetic drill on computer-based teletype	P65-0003
511.1	CHAOS	Number sequence exercise	P65-0006
511.1	ORDER	Numerical pattern recognition	P65-0005
511.1		Significant figures	P66-0111
511.4		Addition of fraction	P65-0023
512		Relationship of kinematics to calculus	P66-0104
512		Initiation a l'algebre	P66-0011
512		Mathematics, signed numbers	P66-1022
512.076		Remedial algebra	P66-1004
512.8	ARRAYS	Arrays of symbols	P65-0024
512.895		Vector operation	P66-0112
513.1		Perimeter of polygons	P65-0022
514		Trigonometric identities	P66-0806
514		Trigonometry	P66-0113
516		Geometry	P66-0803
519		Statistics	P66-0626
519		Statistics	P66-0013
519		General summation statistics program	P65-1217
519		Two-way multivariate analysis of variance	P65-0715
519	PRESTAT	Mathematics, pre-statistics	P66-1029
519.6		Analysis of variance	P66-0612

Physics

530	"AYI"	Physics	P66-1012

530	TENSION	Physics	P66-1033
530		Physics, fundamental interactions and physical constants	P66-1027
530.8		The metric system	P66-0108
531.11		Physics, motion of a particle	P66-1019
531.2	PHYSICS 1	Statics problem	P66-1026
531.3		Elementary science lesson	P65-0009
531.6	ENERGY	Physics, momentum and elementary mechanics	P66-1014
532.2	ARCH	Simulated laboratory experiment using Archimedes principle	P65-0015
532.6		Surface physics research experiment	P65-0013
536	HEAT	Temperature, heat, expansion, change of state	P66-1111
537.11		Maxwell's equations	P65-0032
537.2		Electrostatics	P66-1103
538		Basic magnetism	P66-1102

Chemistry and allied sciences

540		Chemistry lab - qualitative analysis	P66-1002
540	PYROS 1, 2, 3	Demonstration of "The Fire Triangle"	P66-1206
541	CHEM	Laboratory simulation and exercises	P66-0613
541	WMEXPL	Chemistry lab program-simulated	P66-0628
541.24		Atomic structure	P66-0109
545.2	CHEM	Chemistry laboratory simulation titration	P66-0614

Anthropology and biological sciences

574.1	PHYSIO	Physiology	P66-1028
575.1	GENETICS	Biology introduction to genetics	P66-1017

Medical sciences

610.73	NURSING	Medical science	P66-1024
612.85		Introduction to audiology	P66-0101
614	EPITEST 1	Epidemiology	P66-1015
614	EPITEST 2	Epidemiology; herd immunity	P66-1016
616.075		Health sciences: medical diagnosis	P66-1110
616.124	MEDICARE	Lesson on care of patient with myocardial infraction	P65-0004
617.7		Basic ophthalmology	P67-0102
617.7		Neuro-ophthalmology	P67-0101

Engineering and allied sciences

621.3		Network synthesis	P65-0027
621.3		Circuit analysis	P65-0025
621.3		Circuit analysis	P65-0014

Business and related sciences			
657.42		Cost accounting	P66-0102
658.15	COSTACCT	Cost accounting	P65-0007
658.407		Administrator's inbasket exercises	P66-0620
658.5		Production schedules	P66-1109
659.15	DEMO	Demonstration programs for exhibits, displays, etc.	P66-0616
Assembled etc. products			
681.2		Use of micrometer and vernier caliper	P66-1101
Architecture			
720	ARCH 1	Architecture	P66-1011
Photography			
778.534 7	CIRCLE	Test program for producing animated films via PLATO	P65-0035
Music			
781.22	MUSPITCH	Basic concepts in music-properties of musical sound	P66-0621
Literature and rhetoric			
808.02	CRSWRTR	Development of COURSEWRITER course	P66-0615
Germanic languages literature			
830	LANG	French, German, and Spanish translations	P66-1020